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THE LITERATURE OF GAMING, SIMUALTION,
AND MODEL-BUILDING: INDEX AND CRITICAL
ABSTRACTS

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June 1972

The Literature of Gaming, Simulation, and Model-Building: Index and Critical Abstracts

M. Shubik, G. Brewer and E. Savage

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A Report prepared for
ADVANCED RESEARCH PROJECTS AGENCY

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SANTA MONICA, CA 90406

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10. ABSTRACT A bibliography of professional literature on gaming, model-building and simulation, attempting to cover as much of the work in these fields as possible. Each listing is abstracted, indexed and classified, as well as coded according to an evaluation scheme.		11. KEY WORDS GAMING BIBLIOGRAPHY COMPUTER SIMULATION 11

PREFACE

In 1970 and 1971, Rand conducted a critical evaluation of the activity and products of gaming, model-building, and simulation, under the sponsorship of the Defense Advanced Research Projects Agency. The specific aim of that inquiry was to assess the usefulness of gaming in military-political policymaking. Its general aim was to contribute to the definition of common standards and the refinement of objectives that are necessary to the advancement of the gaming profession.

As means to those ends, the authors compiled a bibliography of the professional literature of the past thirty years and made a critical review of much of it. This report describes their bibliographic and classification system and presents indexes and abstracts of the publications entered in it. Longer interpretive reviews of some of those publications are presented in a companion report, R-732-ARPA, *Reviews of Selected Books and Articles on Gaming and Simulation*, by Martin Shubik and Garry D. Brewer. A related study by the same authors is R-1060-ARPA, *Models, Simulations, and Games—A Survey*.

Dr. Shubik, a consultant to The Rand Corporation, spent the academic year 1970-1971 in Santa Monica on leave from Yale University, where he is Professor of the Economics of Organizations. Dr. Brewer and Mrs. Savage are members of Rand's Social Science Department.

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I. INTRODUCTION

The crisis resulting from the "information explosion" in the intellectual disciplines is often exacerbated by something that should alleviate it: the classification and abstracting of professional literature. Abstracting is regarded as a low-grade service to be performed by already overburdened research assistants. Thus depreciated, it is small wonder that abstracts rarely give an indication of the quality of the literature or its professional contribution, and that they are seldom even read. The present study is an effort to upgrade both the activity of classifying and abstracting the professional literature and its results in usefulness to the practitioner.

The authors have made a broad survey of the literature on model-building, simulation, and gaming, attempting to cover as much of the work in these fields as possible. To manage this large bibliography, they adapted a computer-based file management system developed at Rand that stores and dispenses bibliographic and evaluative data of publications.* When complete, the bibliography should contain several thousand entries. The file is regularly updated. In time, it is hoped, the file will be able to produce specialized bibliographies at the request of members of the professional community for a small fee. One could ask for a bibliography based on any of the numerous possible combinations of classification categories—for example, all publications that deal with operational gaming, that were published before 1945, that were funded by the Army, and that are rated excellent.

This Report deals with a subset of the large bibliography, that is, publications that struck the authors as deserving of detailed classification and a critical review.** Section II depicts the classification scheme, and Appendixes A and B respectively show a sample coding sheet and describe in detail the steps taken to produce the indexes and abstracts that appear in Sections III-V. A few publications, believed to warrant even further comment, are duly listed in Sections III-V, but instead of being abstracted, they are treated in Martin Shubik and Garry D. Brewer, *Reviews of*

* The Mark IV File Management System.

** Emphasis in this subset is on unclassified, secondary studies. The authors' approach to games themselves is presented in Martin Shubik and Garry D. Brewer, *Questionnaire: Models, Computer Machine Simulations, Games and Studies*, The Rand Corporation, P-4672, August 1971. The authors plan later to issue an analogous survey of the classified literature.

Selected Books and Articles on Gaming and Simulation, The Rand Corporation, R-732-ARPA.

Key problems faced in the production of a referenced bibliography are the selection of classification categories and the measurement of attributes. Ideally, publications should be classified according to an optimal set of m properties, each of which has an operationally useful measure. The m might be a measure that naturally attaches to a property; for example, one could rate or evaluate a publication on a continuous scale from 0 to 1 or on a discrete scale from 1 to 10. In other cases, a binary 0/1 or Yes/No measure might be more appropriate. Often, though, quantitative measures are not applicable—for example in indicating how complex a game is. Besides the immediate difficulty of arriving at an operational definition of "complexity," it is doubtful that the concept allows a transitive rendering. It would be neatest and most tractable if each property could be expressed on a 0 to 1 scale. Then the classification scheme could be represented by an m -dimensional space, and any specific categorization would be a point in that space.

The procedure followed here has been more prosaic, and a price has been paid for the convenience and simplicity of adapting the existing Rand system. Part of the price is a loss of descriptive precision. For example, though the system allows for coding a publication in multiple subject categories, it cannot allow for the coding of the relative amounts of each.

The categories and their definitions, likewise, are imperfect, but they are a serviceable starting point. As a check on reliability, the authors discussed both the categories and the actual coding-evaluation of each publication until they arrived at a consensus. The abstracts were individually written but collectively scrutinized for comprehensiveness and fairness. A more sophisticated alternative to this triadic method would be to retain a slightly larger group of professionals as an evaluation panel for professional publications. They would review the same publications independently, and then their views would be polled by one of several methods available to obtain unbiased group evaluations.*

Amidst the diversity of current activities in model-building, simulation, and gaming, a community of professionals is emerging. The authors hope here to provide some of the tools for the definition of standards and refinement of objectives that will advance this development.

* The Delphi Method developed at Rand might be adapted to this purpose. Conceived as an alternative to simulation in long-range forecasting, Delphi is a means of soliciting the opinions of experts through successive, individual interrogations, during which an expert is fed information about the opinions of other experts and is given a chance to reconsider and revise his views. After several iterations, a statistical group opinion is calculated. See O. Helmer, *Analysis of the Future: The Delphi Method*, The Rand Corporation, P-3558, March 1967, and N. C. Dalkey, *Delphi*, The Rand Corporation, P-3704, October 1967.

II. THE CLASSIFICATION SYSTEM

- 1-0 ABSTRACTED: AUTHOR
- 1-1 ABSTRACTED: NO
- 1-2 ABSTRACTED: REVIEWED
- 1-3 ABSTRACTED: YES

Comments

- 1-0 If the publication is printed with a useful abstract, it is used as is or with minor modifications or supplementary remarks.
- 1-1 Includes publications whose contents are adequately described by their titles, are short in length, or otherwise do not warrant a full abstract.
- 1-2 Publications deserving fuller treatment. They are reviewed in Martin Shubik and Garry D. Brewer, *Reviews of Selected Books and Articles on Gaming and Simulation*, The Rand Corporation, R-732-ARPA.
- 1-3 Most of the publications in this survey, abstracted by the authors.

- 2-0 ARTICLE TYPE: ALLIED TOPIC, RELEVANT
- 2-1 ARTICLE TYPE: DISCURSIVE
- 2-2 ARTICLE TYPE: GAME DESCRIPTION
- 2-3 ARTICLE TYPE: GAME DOCUMENTATION
- 2-4 ARTICLE TYPE: GAME RESULTS

Comments

- 2-0 Many topics, not strictly gaming, simulation, and model-building, have been included in this survey if they are related to gaming in important ways. For example, social psychological

treatments of learning theory and behavior have important general implications for the design and planning of educational games.

2-1 "Discursive" is not used in a pejorative sense, but implies that a publication is abstract, lightly covers a number of topics, or discusses gaming in a non-gaming context.

The remaining categories are self-explanatory. The reader will recall, however, that multiple categories may be checked for the same publication. For example, if a game is briefly noted in a publication on the teaching of an unrelated topic, 2-0, 2-1, and 2-2 would perhaps be checked.

- 3-0 CLASSIFICATION: CONFIDENTIAL
- 3-1 CLASSIFICATION: FOUO
- 3-2 CLASSIFICATION: NATO CONFIDENTIAL
- 3-3 CLASSIFICATION: NA; UNCLASSIFIED
- 3-4 CLASSIFICATION: SECRET
- 3-5 CLASSIFICATION: TOP SECRET

Comments

Classification as determined by the U.S. government. Foreign or specialized equivalents will be adapted to this list where appropriate.

3-3 Includes publications subject to special export control: each transmittal to a foreign government must have the prior approval of O.N.R., Code 462.

- 4-0 FUNDING SOURCE: ARPA
- 4-1 FUNDING SOURCE: FOUNDATION
- 4-2 FUNDING SOURCE: JCS
- 4-3 FUNDING SOURCE: NA
- 4-4 FUNDING SOURCE: OTHER
- 4-5 FUNDING SOURCE: OTHER DOD
- 4-6 FUNDING SOURCE: OTHER U.S. GOVERNMENT
- 4-7 FUNDING SOURCE: PRIVATE (BUSINESS, SELF, MISC.)
- 4-8 FUNDING SOURCE: UNIVERSITY
- 4-9 FUNDING SOURCE: USA
- 4-10 FUNDING SOURCE: USAF
- 4-11 FUNDING SOURCE: USN

Comments

- 4-1 Loosely defined; includes the National Science Foundation, private foundations, and internally generated Rand research.
- 4-4 Includes foreign governments.
- 4-6 All non-DOD operating agencies.

5-0 GAME FACILITY ()

Comments

If the work described in the publication has been done at any formal gaming facility, the name is entered here. Most often it is left blank; whether it is filled in or not is useful in indicating the growth of formal gaming centers. This and category 6 are the only open-ended categories in this classification system. Calling for a printout of category 5 or 6 will yield a list of organizations and people most active in the field, as reflected by the literature.

6-0 GAME NAME ()

Comments

If a game or a gaming experiment rated OF NOTE or EXCELLENT has not been named by its author, the present authors give it a name. If a descriptive name does not apply, the game is called by the name of its author, plus, if it is one of several by him, a number designating the order in which the publication was read, not the relative date the game was devised. Whether a game rated below OF NOTE or EXCELLENT is given a name depends on other considerations, such as the intrinsically high value of a game that has been written up indifferently, or its being particularly exemplary in a negative way.

- 7-0 MATHEMATICAL SOPHISTICATION: 1. NONE
- 7-1 MATHEMATICAL SOPHISTICATION: 2. SLIGHT
- 7-2 MATHEMATICAL SOPHISTICATION: 3. MODERATE
- 7-3 MATHEMATICAL SOPHISTICATION: 4. MIDDLING
- 7-4 MATHEMATICAL SOPHISTICATION: 5. HIGH

Comments

Duels, pursuit and evasion games, and much of the literature on game theory are often presented in highly technical mathematical form, and few except a small number of specialists are able to follow the discussion. On the other hand, many free-form games use little or no special abstract symbol manipulation, relying instead on simple algebra or perhaps elementary difference or differential equations. Characterizing the moderate to middling range is largely a matter of judgment, but in general it corresponds to the density and difficulty of the symbols used.

- 8-0 PURPOSE: ENTERTAINMENT
- 8-1 PURPOSE: EXPERIMENTAL
- 8-2 PURPOSE: OPERATIONAL
- 8-3 PURPOSE: OTHER
- 8-4 PURPOSE: POPULARIZATION, ADVOCACY
- 8-5 PURPOSE: RESEARCH/THEORY DEVELOPMENT
- 8-6 PURPOSE: TEACHING
- 8-7 PURPOSE: TRAINING

Comments

A game's primary purpose is not always evident, nor is a stated purpose necessarily the real one. The category 8-4 includes a few cases of what appeared to be thinly veiled advertising or hucksterism.

- 9-0 QUALITATIVE ASSESSMENT: 1. NOT EVALUATED
- 9-1 QUALITATIVE ASSESSMENT: 2. EXCELLENT
- 9-2 QUALITATIVE ASSESSMENT: 3. OF NOTE
- 9-3 QUALITATIVE ASSESSMENT: 4. MODAL
- 9-4 QUALITATIVE ASSESSMENT: 5. LIMITED USE
- 9-5 QUALITATIVE ASSESSMENT: 6. BAD

Comments

The present authors accept responsibility for misjudgments that may occur in the sensitive realm of assessing quality. In having met regularly to reach a consensus on the precise classification and abstract of each publication, they trust that they have minimized such errors over what a single evaluator could do. The authors look forward to the time when

a larger sample of expert opinion will engage in a continuous review of the professional publications (see above, p. 2). Both the means and the extremes of their polled judgments will be important, the means to show informed consensus, and the extremes to warn of "outliers" and significant new ideas that may initially find little favor in the establishment. The latter suggests a problem in the sociology of science as well as in its substance.

- 10-0 RAND PUBLICATION: DOCUMENT; INTERNAL NOTE; WORKING NOTE
- 10-1 RAND PUBLICATION: NA; NOT RAND
- 10-2 RAND PUBLICATION: PAPER
- 10-3 RAND PUBLICATION: RESEARCH MEMORANDUM; REPORT

Comments

This category has been added because much of the literature in the field has emanated from The Rand Corporation.

- 11-0 SUBJECT: ARTIFICIAL INTELLIGENCE
- 11-1 SUBJECT: BARGAINING/BIDDING
- 11-2 SUBJECT: BUSINESS/OR/LOGISTICS
- 11-3 SUBJECT: ECONOMICS
- 11-4 SUBJECT: EDUCATION
- 11-5 SUBJECT: GAME THEORY
- 11-6 SUBJECT: GAMING THEORY, METHODOLOGY, AND TECHNOLOGY
- 11-7 SUBJECT: OTHER
- 11-8 SUBJECT: POLITICAL-DIPLOMATIC-MILITARY
- 11-9 SUBJECT: POLITICAL SCIENCE
- 11-10 SUBJECT: SOCIAL PSYCHOLOGY/PSYCHIATRY
- 11-11 SUBJECT: SOCIOLOGY/ORGANIZATION THEORY
- 11-12 SUBJECT: URBAN PLANNING/ECOLOGY
- 11-13 SUBJECT: WAR GAMING

Comments

Where the subject of a publication is not clear-cut, multiple subjects have been marked. A publication describing a scenario, for example, would be

classified under the subject of the scenario, and perhaps also under 11-6, especially if it discussed methodological problems in scenario writing.

- 11-5 The more abstract, esoteric category, this also subsumes studies that suggest game-theoretic applications to other fields, such as organization theory, if highly sophisticated mathematics are used.
- 11-6 Emphasizes the mechanics of gaming: hardware, software, and facilities.

- 12-0 TYPE PUBLICATION: BIBLIOGRAPHY
- 12-1 TYPE PUBLICATION: BOOK
- 12-2 TYPE PUBLICATION: JOURNAL ARTICLE/CHAPTER IN A BOOK
- 12-3 TYPE PUBLICATION: POPULAR ARTICLE/MAGAZINE
- 12-4 TYPE PUBLICATION: TECHNICAL REPORT
- 12-5 TYPE PUBLICATION: UNPUBLISHED PAPER

Comments

- 12-4 Rand Papers, for example, are classified in this category.
- 12-5 Includes casual papers, memos, etc., that can be acquired only through private means.

- 13-0 YEAR PUBLISHED: 1945 OR BEFORE
- 13-1 YEAR PUBLISHED: 1946-1950
- 13-2 YEAR PUBLISHED: 1951-1955
- 13-3 YEAR PUBLISHED: 1956-1960
- 13-4 YEAR PUBLISHED: 1961-1965
- 13-5 YEAR PUBLISHED: 1966-1970
- 13-6 YEAR PUBLISHED: 1971-

III. INDEX BY CATEGORY

The number at the end of each citation denotes the placement of the abstract for that publication in Sec. V.

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D-45006 *A Computer Program for an Oligopoly Business Game* (New Haven: Yale University, Technical Report No. 6, 1970).

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D-94652 *Behavioral Processes in Different Minimal Social Situations* (New Haven: Yale University, unpublished paper, 1970).

D-94653 *Interpersonal Systems* (New Haven: Yale University, Technical Paper, 1970).

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D-79062 *Man-Machine Simulation Models* (New York: John Wiley & Sons, Inc., 1969).

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D-07907 'Leadership in Small Groups: A Mathematical Approach,' *Journal of Experimental Psychology*, Vol. 69, No. 2 (1965), pp. 126-134.

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D-97501 'Games Can Teach the Boss His Business,' *CHANGING TIMES The Kiplinger Magazine* (November 1970), pp. 45-47.

D-97502 *World Politics Simulation* (Washington, D.C.: Industrial College of the Armed Forces, 1969).

D-97503	<i>Directory of Organizations and Activities Engaged or Interested in War Gaming</i> (Bethesda, Maryland: United States Army Strategy and Tactics Analysis Group, 1963).	D-97512	'The War Game and How It Is Played: Mimic Warfare for the Schooling of Army Officers,' <i>Scientific American</i> (December 5, 1916), pp. 470-471.
D-97504	<i>Manual War Gaming</i> (Newport, Rhode Island: United States Naval War College, 1969).	D-97513	'New Tools: Education's Emerging Technology,' <i>Progressive Architecture</i> , Vol. 69, No. 4 (April 1968), pp. 134-145.
D-97505	<i>The General</i> (Baltimore, Maryland: Avalon Hill Co., since 1963).	D-97514	<i>Spartan International: The Magazine of Simulation Games</i> (Long Beach, Calif.: Spartan International, since 1969).
D-97506	<i>Seventy-Five Years of Fun, The Story of Parker Brothers, Inc.</i> (Salem, Mass.: Parker Brothers, Inc., 1958).	D-97515	<i>The State-of-the-Art in Urban Gaming Models</i> (Environmetrics, Inc. for the Department of Transportation, Washington, D.C.: July 1971).
D-97507	<i>Recommended System of Toy Classification</i> (New York: Toy Manufacturers of the U.S.A., Inc., 1965).	D-97516	'Children's Games and Sports,' <i>Encyclopedia Britannica</i> , Vol. 5 (1969), pp. 517-520.
D-97508	<i>Notices of Research Projects in Gaming, Game Theory</i> (Washington: Science Information Exchange, Smithsonian Institution, 1971).	D-97517	<i>Mathematical Model Building in Economics and Industry</i> (London and New York: Hafner Publishing Co., 1968), C-E+R Ltd.
D-97509	'Navy Unveils Electronic War 'Game',' <i>U.S. Naval Institute Proceedings</i> (January 1959), pp. 136-137.	D-97518	<i>Game Theory and Its Application to the Social Sciences: A Bibliography</i> (Washington, D.C.: Bureau of Intelligence and Research, U.S. Department of State, January 1964), External Research Staff, U.S. Department of State.
D-97510	<i>Simulation: Technical Journal of Simulation Councils, Inc.</i> (La Jolla: Simulation Councils Inc., Published Monthly, 1963 to date).	D-97520	Environmental Systems Group, Institute of Ecology, University of California, Davis, <i>A Model of Society</i> , Report No. 1 (Davis, Calif.: April 1969).
D-97511	<i>First Tooling-Up Exercise for Logistics Systems Laboratory</i> (October-November 1956) (Santa Monica: The Rand Corporation, RM-1924, July 1957).		

V. ABSTRACTS

D-00081* *Survey of the State of the Art: Social, Political, and Economic Models and Simulations* (Cambridge, Mass.: Abt Associates, Inc., 1965). C. C. Abt. November 1965.

This is a report of a hasty (3-month) survey of computer models (including straight econometric models) in simulation and gaming. A questionnaire was circulated to 80-90 institutions and persons, to which 10-15 percent responded. Others were interviewed personally. Some information on costs is given. 81 pp.

D-00082 *Serious Games* (New York: The Viking Press, 1970) C. C. Abt. 1970.

Not abstracted; reviewed in R-732-ARPA.

D-00083 'War Gaming,' *International Science and Technology* (August 1964), pp. 29-37. C. C. Abt. August 1964.

Coded; Not abstracted; not reviewed.

D-00361 'Simulation of Air Operations with the Air-Battle Model,' *Operations Research* Vol. 8 (September-October 1960), pp. 600-615. R. H. Adams, J. L. Jenkins. September-October 1960.

Not abstracted; reviewed in R-732-ARPA.

D-02042 'An Appreciation of Industrial Dynamics,' *Management Science* Vol. 14, No. 7 (March 1968), pp. 383-397. H. T. Ansoff, D. P. Slevin. 1968.

An attempt at an impartial assessment of industrial dynamics approximately ten years after its inception. Little evidence was found to indicate that industrial dynamics should be viewed as a distinctive body of theory about the behavior of firms. Both this article and a rebuttal by Forrester (D-28353) are devoid of discussion of actual applications of the discipline and their success or failure. 15 pp.

D-02141 'An Experiment on Behavioral Learning in a Consumer Credit Game,' *Simulation & Games* Vol. 1, No. 1 (March 1970), pp. 43-54. C. R. Anderson. 1970.

A group of 280 students was given a set of experiments designed to compare the effectiveness of consumer-credit instruction through gaming and through conventional classroom methods. Gaming proved to be as effective as conventional methods for factual learning—more effective in the case of students majoring in business education. Men had a slight advantage over women in the gaming context. 9 pp.

D-02001 *Instructional Simulation Systems in Higher Education* (Cambridge Institute of Education, 1970). R. H. R. Armstrong, J. L. Taylor. 1970. Not abstracted; reviewed in R-732-ARPA.

D-03661 *Dilemmas in the Politico-Military Conduct of Escalating Crises* (Santa Monica: The Rand Corporation, P-3205, 1965). H. Averch, M. M. Lavin. August 1965.

A summary description of a series of games played at Rand to explore the effects of crisis management situations on military and political participants. Specifically, it examines command and control problems of political actors over military forces in environments of high uncertainty. It is argued that the different responsibilities, perceptions, and operational styles of the participants account for the divergence in the strategies they recommend. The role of information is downgraded in this exercise because neither group is denied essential data. Whatever differences exist are primarily attributable to orientational differences. Good general discussion of some fundamental problems. 12 pp. *

D-03662 *Simulation of Decisionmaking in Crises: Three Manual Gaming Experiments* (Santa Monica: The Rand Corporation, RM-4202-PR,

1964). H. Averch, M. M. Lavin. August 1964.

This describes how gaming techniques were used in examining three hypothetical European crises occurring in the late 1960s. The aims were to identify some of the political and military constraints that affect national decisionmaking during crises; to discern whether or not common patterns of action appear in different crises; and to infer military requirements in crises. On the basis of the gaming experience, the authors make judgments about: (1) the effects of the three-game structure on decisionmaking; the quality and quantity of decisions in these games compared with decisions in real crises; (2) the escalation of violence in the games compared with that in real crises; (3) the impact of internal and external information flows on the game decisions; (4) questions identified by these plays that deserve further study. The authors found that differences in game structure affect the conduct of hypothetical crises in important ways. For example, these differences sometimes govern the impact of threats and diplomatic moves, dictate the pace of escalation, and interfere with perceptions of an adversary's objectives. Regulating the information flows within a crisis game is exacting and vital. Circumscribing the role of the Control team is troublesome. Notwithstanding these and other difficulties, their experience suggests that manual gaming, though not a means of predicting crises, can identify many factors likely to enter future crisis decisionmaking. Also it can assist military planners in anticipating the needs of crisis decisionmakers. They judge that, considering the importance of its objectives, the cost of such gaming is moderate compared with other research techniques. The gaming procedures described are but three of a broad range of possibilities. This type of gaming is adaptable to a variety of research needs. This is an excellent, thoughtful article. More work of this caliber is needed. 31 pp.

D-03041 *A Voting Game* (New Haven: Yale University, unpublished paper, 1966). R. Axelrod. 1966.

This paper is an imaginative attempt to construct and operate a voting game that replicates aspects of the legislative process. The game's heuristic, educational, and experimental purposes are clearly sketched out. Eighteen 'soft' propositions about legislative behavior are advanced and checked against the game play. Rules and a summary of one iteration of play are provided. Experimental data generated in the run are presented and cursorily analyzed. This document shows that much has been derived from very few resources. A genuine educational purpose has been fulfilled with a cheap, easy to use, and highly imaginative game. 28 pp.

D-04001 'The M.I.T. Political-Military Gaming Experience,' *ORBIS* Vol. 9 (Summer 1965), pp. 437-458. R. E. Barringer, B. Whaley. Summer 1965.

The article describes a survey made of the participants in the series of political-military games conducted at M.I.T.'s Center for International Studies since 1958. A personal interview of a small group was made and a questionnaire mailed to most of the gamers. The questionnaire and many interesting results are presented in the article. The respondents were asked their opinions about the uses of gaming as a technique for teaching and training, as an adjunct to policy planning, and as a research tool. Gaming subjects are compared as to utility and learning value. Gaming as a learning experience is discussed, with the conclusion that it is a sensitizing process that heightens awareness of things already known. The familiarization problem is discussed. Respondents thought that prior participation in a political-military exercise increased the quantity and quality of the policy alternatives they perceived. Benefits and limitations of games are noted all through the article, making it an extremely important appraisal of games as participants see them. 21 pp.

D-04003 'The Game and the Myth as Two Languages of Social Science,' *Behavioral Science* Vol. 8 (January 1963), pp. 66-71. K. Beck. 1963.

Instead of attributing disputes among social scientists to philosophical differences, as is usual, the author attributes those disputes to linguistic differences. Model-makers and gamers, whose work stresses rigorous control,

*This number should not be confused with the D-number used to identify Rand internal documents.

definition, and management, use a different language (although the component words have the same verbal distinctions) than humanists, who transcend the denoted meanings of words to intuit notions of social structure and process. Examples cited are Harold Guetzkow's Inter-Nation Simulation versus Arnold Toynbee's representation of international relations, and the work of experimental psychologists versus that of Freud and his followers. Gaming and game theory are singled out as being particularly important to the development of the social sciences; but the author argues that the rigor and precision of gaming should be accompanied by the creation of 'myths,' 'which are relevant but have no precision,' and then the results of the two approaches should be compared. Thus, the ideal social scientist should 'not be a mongrelizer, but he should be bilingual.' 7 pp.

D-04004 'Gaming and Simulation in International Relations.' *Political Studies*, Vol. 16, No. 1 (1968), pp. 1-17. M. H. Banks, A. J. R. Groom, A. N. Oppenheim. 1968.

A restatement of the old saga: first came Kriegsspiel, which developed and changed over the years; then came the Japanese with their Total War Research Institute, which justified Pearl Harbor; then there were Goldhamer and Speier and the political games at The Rand Corporation; Bloomfield and Guetzkow were stimulated to develop, respectively, crisis games and the Inter-Nation Simulation; others became interested and were trained but did not produce much that was either new or very useful; TEMPER was attempted, did not prove worthwhile, and was set aside. 18 pp.

D-04005 *A Primer on Simulation and Gaming*. Englewood Cliffs, N. J.: Prentice-Hall. 1970. R. F. Barton. 1970.

Not abstracted; reviewed in R-732-ARPA.

D-04005 'Business Games, Models, and Accounting.' *Journal of Accountancy*, Vol. 109 (March 1960), pp. 56-60. C. W. Bastable. 1960.

A discussion of the conjunction between accounting and gaming for theory development and training purposes. The author gives several dramatic illustrations of what different accounting procedures imply for the decisionmaking of a business firm. Of course, a game is played for the benefit of the accountant to give him a better idea of different outcomes. Though its attempt to model some aspects of accounting theory is very crude, the article is important in demonstrating yet another promising application of games. 5 pp.

D-04007 *Review of TEMPER Model-Final Report* (Princeton, N. J.: Mathematica Corp., September 1966). M. Balinski, K. Knorr, O. Morgenstern, F. Sand, M. Shubik. 1966.

A series of five critical reviews of the TEMPER model. The first deals with the actual model in simulation, its purposes and uses. The second addresses the political inputs in the structure, the third the economic inputs, the fourth bargaining, negotiation, and strategic decisionmaking, and the fifth the data base. The reviewers conclude that the model is not viable as an instrument of research and that it would be cheaper to scrap the model and start over than to attempt to salvage it. 123 pp.

D-05001 *Games People Play* (New York: Grove Press, 1964). E. Berne 1964.

Not abstracted; reviewed in R-732-ARPA.

D-05002 *The Psychology of Gambling* (New York: Hill and Wang, 1957). E. Bergler. 1957.

Not abstracted; reviewed in R-732-ARPA.

D-05003 *Board and Table Games From Many Civilizations* (London: Oxford University Press, 1960). R. C. Bell. 1960.

Not abstracted; reviewed in R-732-ARPA.

D-05004 'Simulation of International Relations and Diplomacy,' in Harold Borko (ed.), *Computer Applications in the Behavioral Sciences* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1965). O. Benson. 1965.

A superficial article on the use of gaming in international relations. 21 pp.

D-05005 *The Role of War Gaming in Military Operational Research* (London: Admiralty, Department of Operational Research, Memo No. 190, January 1961). E. M. L. Beale. 1961.

This is a rather disappointing rehash of several well-known articles on gam-

ing, including C. J. Thomas and W. Deemer, 'The Role of Operational Gaming in Operations Research' (D-85936, below) and M. G. Weiner, 'Gaming' (D-91615, below). The author seems to have added nothing to the original pieces and in several places states points less well or even incorrectly. 32 pp.

D-05006 'Organization Structure and Complex Problem Solving.' *Administrative Science Quarterly*, Vol. 14, No. 2 (June 1969), pp. 260-271. S. W. Becker, N. Baloff. 1969.

Based on an analysis of task characteristics and group problem-solving behavior, the division-of-labor form of organization was hypothesized to be superior in performance to the committee or hierarchical forms in a business game or simulation. These experimental results strongly support the hypothesis. An interaction was also found between organization structure and rate of improvement in performance. It was greatest among groups whose initial performance was poor. The problem-solving efficiency of different organization structures is discussed. 12 pp.

D-07906 'Learning and Extinction of Leadership Preferences in Small Groups.' *Journal of Mathematical Psychology*, Vol. 3 (1966), pp. 129-39. A. Binder. 1966.

This experiment involved a three-person game in which the members voted for a leader; the designated leader then made a decision for the group. The amount of reinforcement each member was given for his decisions as leader was under experimental control. Earlier work with this game had reported a correspondence between observed voting behavior and that predicted for a Markov model based on the reinforcement probabilities. Voting choices showed learning trends and asymptotic states that were predictable to a significant extent from the model. In the present experiment, a variation was introduced midway in the game whereby members were reinforced equally instead of differentially. The subjects showed sensitivity to the shift by changing their voting preferences. The Markov model proved generally adequate at asymptotic predictions. 11 pp.

D-07907 'Leadership in Small Groups: A Mathematical Approach.' *Journal of Experimental Psychology*, Vol. 69, No. 2 (1965), pp. 126-134. A. Binder, B. R. Wolin, S. J. Terebinski. 1965.

Coded; not abstracted; not reviewed.

D-07908 'Effect of Three Voting Rules on Resource Allocation Decisions.' *Management Science*, Vol. 16, No. 6 (February 1970), pp. B356-B372. J. G. Birnberg, L. R. Pondy, C. L. Davis. February 1970.

This paper is concerned with the effect of the voting rule adopted by a Capital Budgeting Committee on the allocation of resources among divisions. A laboratory experiment indicates that the different voting rules have different characteristics measured in terms of the size of the total budget allocation made and the inter-division variability. The literature of behavioral research on resource allocation is divided into three groups: (1) approaches that attempt through observation of organization or decisions to isolate decision rules, (2) those concerned with interpersonal or intergroup strategies, and (3) those concerned with processes by which individual sub-units aggregate their decisions. 16 pp.

D-07909 'Code 50: A Multi-Weapon, Multi-Target Nuclear Exchange War Game.' (Paper presented at AMRAC Proceedings, ARPA: Project Defender, November 1967). J. H. Bick, H. Everett. November 1967.

CODE 50 is a three-move, all-computer, highly complex, multi-strike war game. The basic scenario consists of a first strike, a counter-strike with all surviving weapons, and a third and final strike by the initial attacker using uncommitted and undestroyed weapons. Though this paper is little more than a crude outline of CODE 50, it reveals several interesting things: (1) the game has no geography, although the description alludes to a requirement for bigger computers, (2) weapon and target types are limited in number by the computer program, not the empirical context, (3) time is not specifically represented in the game because of the simple analytical forms selected, and (4) input data requirements are astronomical, and one wonders how many of the model parameters have been calculated or only guessed at. Finally, CODE 50 is reported able 'to make up war plans for both sides even down to the level of preparing sorties for the individual bombers,' and the authors 'almost daily, in response to the wishes of our contractors, . . . make changes in (the game).'

D-08381 'The Political-Military Exercise: A Progress Report,' *ORBIS*, Vol. 8 (Winter 1965), pp. 854-870. L. P. Bloomfield, B. Whaley. Winter 1965.

The article is a report of the M.I.T. Political-Military Exercise. A review of the policy-level political-military game is presented, including: how a game is organized, the time to play the game, the physical arrangements of the game, the administrative staff, and the playing of the game. Examples are drawn from the M.I.T. POLEX and POLEX-DAIS games. The implications of political gaming for serious policy and for teaching and training are identified. The authors suggest topics for further research in gaming such as game realism, personal involvement of the participant in the game, and misperception of messages from the other team. 16 pp.

D-08382 'Three Experiments in Political Gaming,' *American Political Science Review*, Vol. 53 (December 1959), pp. 1105-1115. L. P. Bloomfield, N. J. Padelford. December 1959.

The article describes three games on problems in international affairs held at M.I.T. to see what research and teaching values this technique might yield. One, the Endicott House game, employed senior faculty and research personnel and was conducted under the auspices of the United Nations Project at the Center for International Studies. The other two experiments, using undergraduate students, were held under the Political Science Section. The authors describe the selection of the problem for the games. The Endicott House game posited a change in Poland's regime. The undergraduate games focussed on the Berlin crisis. Time span for the games varied from three days to six weeks depending on the time the players could devote to the game. The game plans are outlined and deviations from the plans during play are noted. The format included bilateral diplomacy, a Security Council meeting, and a meeting of the United Nations General Assembly. Umpires were used to brief the players, give general guidance, and supply new 'facts.' Lessons learned from the experiments are given. For example, a more definite purpose would have been useful. The authors considered the experiments a qualified success.

D-08383 'POLEX: The Political-Military Exercise,' *Military Review*, Vol. 45 (November 1965), pp. 65-71. L. P. Bloomfield, B. Whaley. November 1965.

For *Military Review*, Bloomfield and Whaley revised an article appearing in *ORBIS* (Winter 1965) (D-08381). The result is a gentler pitch for *Military Review*'s select audience. The authors adduce an array of theoretical arguments for policy-relevant, political-diplomatic-military gaming. After all is said we are left with the thought that, "...the teaching and training possibilities of this method may actually outweigh its obviously moot predictive value." (p. 70). Such claims are largely supported by questionnaire responses on which 'officers from all services have commented on the unique usefulness of this device in training senior officers on the sophistication of modern crisis diplomacy' (p. 71). Not knowing how military officers know what crisis diplomacy even looks like, one must discount even these modest claims and supportive 'evidence.' The authors' self-appraisal of POLEX—'excellent for training, useful for teaching and potentially valuable...for policy research and planning' (p. 71)—leaves much to the reader's imagination. 7 pp.

D-08384 *The City as a System* (Jenkintown, Pennsylvania: Decision Sciences Corporation, 1969). D. F. Blumberg. 1969.

Not abstracted; reviewed in R-732-ARPA.

D-08385 *Quantitative and Qualitative Games* (New York: Academic Press, 1969). A. Blaquier, F. Gerard, G. Leitmann. 1969.

Not abstracted; reviewed in R-732-ARPA.

D-08386 *The Political Exercise: A Progress Report* (Cambridge: M.I.T., Center for International Studies, Report C/61-6, March 1961). L. P. Bloomfield. March 1961.

Description of the POLEX games played at M.I.T. in the early 1960s under the leadership of the author. It is sufficient to give only the briefest indication of how the game was designed, set up, and run. However, post-game analysis is touched on in the discussion of the games' free-form technique. The control function is identified as critical, as are the procedural problems inherent in managing such games when the players are senior or distinguished persons. 24 pp.

D-08387 'After Neo-Isolationism, What?' *Bulletin of the Atomic Scientists*, Vol. 27 (April 1971), pp. 9-13. L. P. Bloomfield. April 1971.

Contending that the United States has entered a 'post-Vietnam nonintervention syndrome,' the author calls for several operational changes in the government's way of approaching political-diplomatic-military affairs. Implicitly he also calls for research to adjust these operations to the new foreign-policy climate. He cites as special problems in current policymaking the inability to anticipate the consequences of policy options before they are adopted; the immediate or short-term time-frame that most decisionmakers operate with; and the neglect of nonmilitary factors in making international forecasts. The 'policy games' being played at M.I.T. are mentioned as a useful means of tackling some of those problems. 4 pp.

D-08388 'Lewis Carroll and the Theory of Games,' *American Economic Review: Papers and Proceedings* (1969), pp. 206-216. D. Black. 1969.

This article refers to Lewis Carroll's booklet, *The Principles of Parliamentary Representation* (1884 edition), in which Carroll applied two-person, zero-sum game-theoretical concepts to provide a theory of proportional representation for the apportionment of parliamentary seats. Carroll's proposal merits attention as an historical curiosity, but subsequent and more rigorous work surpasses its substantive and theoretical contributions. See, for example, Robin Farquharson, *Theory of Voting* (New Haven: Yale University Press, 1969). 11 pp.

D-08389 *Anticipating Conflict-Control Policies, The 'Conex' Games as a Planning Tool* (Cambridge: M.I.T. Center for International Studies, C/70-10, February 1970). L. P. Bloomfield. 1970.

A theoretical discussion of the use of professional political exercises and descriptions of four such exercises directed by the author. The discussion covers the possibility of 'predicting' policy behavior, innovations in the 'free-game' technique, data gathering and analysis, and the political exercise as a research tool. The exercises deal with the 'post-Vietnam nonintervention syndrome,' controlling conflict, 'after neo-isolationism, what?,' great-power relations, the multilateral option, and the role of arms and arms control.

D-08390 'Group Decision Making: A Report of an Experimental Study,' *Behavioral Science*, Vol. 10 (July 1965), pp. 277-289. J. L. Bower. July 1965.

This document summarizes in a cursory way some developments in group decision theory and reports on an experiment in which 58 committees, divided into 'rational teams' and 'foundations,' made various budget decisions. A foundation has a transitive group ordering. Members of rational teams each have the same utility but different subjective probabilities. On the average, the teams performed better than the foundations. The author suggests that future experiments should place more stress on the interaction among search, analysis, information structure, and decision rules. 26 pp.

D-08391 *Simulation Games in Learning* (Beverly Hills, California: Sage Publications, 1968). Edited by S. S. Boocock, E. O. Schild. 1968.

Not abstracted; reviewed in R-732-ARPA.

D-08392 *The Protracted Game* (New York: Oxford University Press, 1969). S. A. Boorman. 1969.

This is a fascinating small book that posits a direct analogy between the ancient Chinese game of *Wei-ch'i* (in Japanese, *Go*), and political developments in China. The author discusses the takeover of the Chinese Communists from the very start of their operations in terms of a global *Go* game played on the map of China. The analogy is fascinating; he handles the delicate interrelationship between tactics and strategy judiciously. The concept of encirclement and the concept of extremely tenuous control over large areas of territory are central to this game. The situations discussed are simultaneously more fluid and more static than in chess or in conventional Western thinking about war. If one does not overstretch the analogy, this book is well worth reading.

D-08393 *Computer Applications in the Behavioral Sciences* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1965). H. Borko. 1965.

A compendium of articles arranged in 25 chapters. Quality varies from article to article, but overall, and for its time, the compilation presented a useful and thorough overview for the behavioral scientist wondering what the computer could do for him. Naturally, time-sharing does not appear. Full chapters are devoted to computers and the behavioral scientist; the history

and development of computers; computer functions and applications; data representation; programming fundamentals and machine language; and the university computing center. Other chapters deal with specific topics such as data processing in psychological research, multiple linear regression models, factor analysis, study of perception, automated teaching, simulation of cognitive processes, automatic language data processing, and computer music. 633 pp.

D-09000 'Putting the Dilemma Back Into Prisoner's Dilemma,' *Journal of Conflict Resolution*, Vol. 14, No. 3 (September 1970), pp. 379-387. P. Bonacich. 1970.

The author argues that the rigid play of most Prisoner's Dilemma experiments removes an important element from the analysis: communication among players. He develops an index of the degree of dilemma in the game and illustrates the index in several experiments. The criticism may be valid, but the case presented here is not convincing. 9 pp.

D-09001 *The Structure and Classification of Operational Research Games* (London: Ministry of Defence, Defence Operational Analysis Establishment, Memorandum 7117, June 1971). K. C. Bowen. June 1971.

This paper explores the basic structure and purposes of games. The analysis and classification scheme indicates sequences of games that can be played as logical stages in the understanding of decision processes. Computer simulation and analytical modeling are included with the classification, which is applied to children's games and game theory as well as to operational research games.

D-09006 *Narrative Description of an Analytic Theatre Air Ground Warfare System* (Santa Monica: The Rand Corporation, RM-1428, 1955). J. R. Brom. February 1955.

The Tactical Air-Ground Study (TAGS) is described in detail in a supplement to RM-1338, *Analytic Formulation of a Theater Air-Ground Warfare System*. The present paper presents a thumbnail sketch of the TAGS model, notes its relationship to antecedent research (see RM-1022/1, RM-1072, RM-1338), and makes a case for TAGS' inclusion in Air Force planning practice. Air, ground, and supporting logistics network operations are detailed. This paper is a careful summary that should be read before other documents in the TAGS series. 25 pp.

D-09007 'Techniques for Evaluating Military Organizations and Their Equipment,' *Naval Research Logistics Quarterly*, Vol. 9 (1962), pp. 211-229. P. Brock, W. D. Correll, G. W. Evans. 1962.

As a survey of general, introductory ideas about gaming and analytical approaches, this article is thorough, straightforward, and sensible. If the reader expects, however, to learn much about the evaluation of military systems and equipment, he may be disappointed. The piece is recommended highly for the neophyte gamer. 18 pp.

D-09008 'Computer Programs as Theories of Political Processes,' *Journal of Politics*, Vol. 24 (August 1962), pp. 562-582. R. P. Browning. August 1962.

This article was significant in 1962 for relating the work then being done by Cyert and March and their colleagues at Carnegie Tech to the concerns of political science. Browning's thesis is that computer models can be used effectively to develop (through the cumulative process and the requirement of thoroughness and logical precision) the systematic frameworks necessary to build games of various political processes. Among the processes that Browning considers suitable for computer modeling are routine bureaucratic decisionmaking; problem-solving with the GPS approach; incremental decision processes; events having characteristic feedback and high information content; and certain types of conflict situations characterized by their selection of priorities and sequential treatment of crisis. This was an excellent, thoughtful, insightful article for its time. Unfortunately, the profession generally was not ready for the sophistication of Browning's ideas. Only recently have political scientists, for example J. P. Crecine, begun to do the things that Browning sketched out. 17 pp.

D-09009 *A Technique for Evaluating the Structure of US Army Forces in an Area Domination Role* (McLean, Virginia: Research Analysis Corporation, RAC-TP-412, December 1970). J. A. Bruner, W. N. Flournoy. December 1970.

A highly aggregated, two-sided war game in which the U.S. force operates

from a single base camp to dominate a designated area. Decisions for both sides are made by human players with incomplete information about the opponent's activities. Only one player is required for each side. A game controller assesses detection and the battles manually or with computer assistance. The game is designed to solve force-structure problems. The lack of supporting data makes it impossible to judge the accuracy of the model. The demonstration games used estimates. 168 pp.

D-10000 *Processes in Political Development: Simulating Theories of Political Systems* (Doctoral dissertation, Yale University, 1971). R. D. Brunner. 1971.

A useful essay in model-building and specification in political science. Two verbal theories concerning political development are examined and are translated into computable simulations. While carrying out this task the researcher is able to examine the theories systematically and in great detail. This study should be of interest to any political scientist interested in gaming or simulation. 329 pp.

D-11776 'International Theory: The Case for a Classical Approach,' *World Politics*, Vol. 18, No. 3 (April 1966), pp. 361-377. H. Bull. April 1966.

This is an elegant, gentlemanly protest against 'new-fangled' methods of research in international relations. While one might take issue with his sweeping denunciations of most things quantitative, there is much to be said for Bull's central thesis that the scientific approach has been long on promises and short on goods delivered. What he objects to most is the simplification inherent in any model, simulation, or game. His point is valid; a modeled or gamed context is not the same as the reference system it attempts to describe. Recalling a modeler's dictum to 'model simple but think complex,' Bull seems to be saying that the current crop of scientific theorizers are not thinking at all. For example, with respect to Karl Deutsch and Bruce Russett, Bull remarks that they 'have succeeded in providing figures only to be blinded by the illumination they cast' (p. 374). The main lessons of this article for the serious gamer are (1) keep in active touch with the reference system being gamed, and (2) don't believe your game results per se too strongly. 16 pp.

D-11777 *Game Theory in the Behavioral Sciences* (Pittsburgh: University of Pittsburgh Press, 1969). I. R. Buchler, H. G. Nutini. 1969.

Not abstracted; reviewed in R-732-ARPA.

D-12001 'Monopologs: Management Decision Making Game Applied to Tool Room Management,' *The Journal of Industrial Engineering*, Vol. 11, No. 5 (September-October 1960), pp. 572-577. F. M. Campbell, E. R. Ashworth. September-October 1960.

A description of the civilian version of The Rand Corporation's MONOPOLOGS logistics game. The authors converted the game to the educational setting, simplified it to include a narrow class of inventory control problems, and made it totally manual in the interests of economy. Apparently the demilitarization was successful; according to the authors, the pedagogic goals of generating interest and transmitting information were realized. 6 pp.

D-12002 *Of Man, Play, and Games*, translated from the French by Barash Meyer (New York: The Free Press, 1961; published as *Les Jeux et les Hommes* in 1958). R. Cailliois. 1961.

Not abstracted; reviewed in R-732-ARPA.

D-12003 'Effects of Flat and Tall Organization Structure,' *Administrative Science Quarterly*, Vol. 14, No. 2 (June 1969), pp. 178-191. R. Carzo, J. N. Yanouzas. 1969.

In a laboratory experiment, 'tall' and 'flat' organization structures were tested for their effects on group performance. The tall organization structures were superior on two measures of performance: profit and the rate of return on revenues. Groups with a flat organization took more time to resolve conflicts and to coordinate efforts than did those with a tall structure. 14 pp.

D-14006 'An Experimental Imperfect Market,' *The Journal of Political Economy*, Vol. 56, No. 2 (April 1948). E. H. Chamberlin. April 1948.

This is possibly the earliest article on experimental economic gaming, predating the construction of computer games by several years. Professor Chamberlin ran several experiments in his classes at Harvard to examine the fluctuation around equilibrium in a simple simulated economic market. The

spirit is one of casual experimentation, and the analysis is not thorough. Nevertheless, it is noteworthy in suggesting so early this means of exploring economic models. 14 pp.

D-14487 *COGWHEEL: A Film Story of Systems Research Laboratory's Research Activities* (Santa Monica: The Rand Corporation, P-753, 1955). R. L. Chapman, M. G. Weiner. September 1955.

Coded; not abstracted; not reviewed.

D-14488 *The Background and Implications of the Systems Research Laboratory Studies* (Santa Monica: The Rand Corporation, P-740, 1955). R. L. Chapman, J. L. Kennedy. September 1955.

The System Research Laboratory engaged in the study of complex organizations with the aim of developing ways to look at organizations, evaluate group performance, and train personnel better. This monograph discusses the Laboratory's experiments in which an air-defense direction center was modeled as the complex organization. Results suggest that making a man-machine system work well requires full use of the human group-learning ability. Techniques are devised to exploit this ability in order to maximize use of the system's resources. It appears, further, that the application of the group-learning ability is best investigated through studies of complete systems. Both the theory behind the experiments and their results have implications for system design, especially personnel selection and training. 15 pp.

D-14489 *Job Lot: A Production Management Game* (New York: Macmillan Company, 1970). J. Churchill. 1970.

Coded; not abstracted; not reviewed.

D-14490 *Japanese Chess: The Science and Art of War or Struggle, Philosophically Treated* (New York: The Press Club of Chicago, 1905). C. Yo. 1905.

Not abstracted; reviewed in R-732-ARPA.

D-14491 'Some Current Research on Effectiveness of Educational Simulations: Implications for Alternative Strategies.' *The American Behavioral Scientist*, Vol. 10, No. 2 (October 1966), pp. 4-7. C. Cherryholmes. October 1966.

Report of an examination of six studies of educational effectiveness. It concludes that claims of enhanced learning and attitude change through the educational use of simulation and games are overstated or at least premature. Student learning of facts and principles, retention of information, problem-solving, and attitude change were not found to differ consistently or significantly whether games, simulation, or conventional teaching methods were used. The only observed difference was increased student interest in the case of game-play. Several procedures and educational uses of games other than those examined are mentioned, including having the students design their own games and validate the theoretical structure of existing games. A list of unpublished work on this topic is appended. This article is a rare example of an attempt to grapple with fundamental questions in gaming. 4 pp. (See also D-71783.)

D-14492 'An Empirical Test of Five Assumptions in an Inter-Nation Simulation About National Political Systems.' *General Systems*, Vol. 12 (1967). R. W. Chadwick. 1967.

Five assumptions about interrelations between the political and economic characteristics of nations are explored for their empirical adequacy, clarity of formulation, and logical consistency. The assumptions are (1) Given a specific decision latitude, a high likelihood of retaining office should be associated with a high level of validator satisfaction. (2) Given a specific level of national security, a high level of validator satisfaction should be associated with a high level of consumption satisfaction. (3) Given a specific level of consumer goods in a nation, a high level of consumption satisfaction should be associated with a low-level basic capability. (4) A high likelihood of revolution is assumed to be associated with low levels of validator satisfaction; high levels of decision latitude; and low levels of forced internal control as a proportion of total force capability. (5) National security is assumed to be greater the greater the sum of basic and force capabilities of a nation and its military allies compared with the sum of the capabilities of nations in opposing alliances. Ten variables in the INS model are interrelated with the five basic assumptions. These assumptions were tested by calculating the product moment correlation between a set of indices developed in the article. 16 pp.

D-15551 'Digital Simulation Languages: A Critique and a Guide.' *AFIPS Conference Proceedings*, Vol. 27, Part I, 1965, Fall Joint Computer Conference, pp. 23-36. J. J. Clancy, M. S. Fineberg. 1965.

A compact survey of simulation languages for the simulation of parallel, continuous systems, typified by the MIDAS or DYSAC languages. 14 pp.

D-16056 *An Attack Defense Game with Matrix Strategies* (Santa Monica: The Rand Corporation, RM-4274-I-PR, 1966). N. D. Cohen. August 1966.

This paper presents the results and the method of analysis for an attack-defense game involving the allocation of resources. Each player is assumed to have several different types of resources to be divided in an optimal fashion among a fixed set of targets. The payoff function of the game is convex. The 'No Soft-Spot' principle of M. Dresher, and the concept of the generalized inverse of a matrix are used to determine optimal strategies for each player and the value of the game. 28 pp.

D-16057 'The Role of Management Games in Education and Research.' *Management Science*, Vol. 7 (1961), pp. 131-166. K. J. Cohen, E. Rhenman. 1961.

Given the relative antiquity of this article, one might expect little useful information and fewer insights for the present-day reader. This is not so. Granted, the reader can safely skip over the *de rigueur* recitation of the history of gaming, and he might also skim through the dated descriptions of business games circa 1960. But when the discussion turns to game uses, complexity, purposes, costs, and limitations, full attention is warranted because many of these issues remain as viable as ever. A partial listing follows: (1) At what size do games change their qualitative nature? (2) What effects are noticeable when time is compressed (or expanded) in game play? (3) What effects are attributable to varying levels of risk and uncertainty? (4) How valuable is information? (5) How important is systematic analysis in the course of game play? (6) What are the relations between time and levels of analysis in the game? (7) What does a game really cost? (8) Is a game really the best way to accomplish a given task? (9) Does a given game stimulate or suppress creative urges in players? The article serves as a good reminder, to the practicing gamer, of the vast expanses of supportive research remaining to be done, and, to the neophyte gamer, of the opportunities that beckon. 35 pp.

D-16058 'The Use of a Computer in Conducting Psychological Experiments.' *Behavioral Science*, Vol. 11 (1966), pp. 307-311. A. S. Cooperband. 1966.

This article sketches the major arguments usually adduced for and against computer-based behavioral science laboratories. A 'Collision-Prediction-Situation' on a radar screen, a training and theory-development exercise using a radar screen to predict automobile collisions, conducted at the System Development Corporation, is cited in illustration. The author argues that the 100,000 separate pictorial observations and associated responses generated in the experiment could not have been handled practically except by a computer. A time-shared system was used to generate the pictorial stimuli, to record subject responses, to re-format these data for analysis, to analyze the data, and to print out the results. An average cost of \$37.50 per hour is noted. The conclusion is that great experimental benefits are possible to achieve, in fact have been achieved, but they depend upon enormous sunk costs in programmer time and hardware outlays. Time-sharing or similar, more-or-less general-purpose laboratory facilities might be the only practical way to achieve these benefits. 4 pp.

D-16059 'Inter-Nation Simulation and Contemporary Theories of International Relations.' *American Political Science Review*, Vol. 50 (September 1966), pp. 562-578. W. D. Coplin. September 1966.

The author introduces his article as 'an analytical comparison, primarily on the level of middle-range theory, of the substantive assumptions contained in INS with contemporary international relations theory.' It is in fact a pedantic argument for the use of the Inter-Nation Simulation as a theory device, in support of which the author appends no less than 108 footnotes in 16 short pages. The author has ferreted out laudatory comments on every aspect of INS. By this account Guetzkow and his colleagues rank as the foremost theoreticians in the field. Such unabashed advocacy has little to recommend it. Proposals to develop the 'all computer international relations simulation' represent a form of intellectual entrepreneurship that is ill-suited to this prestigious professional journal. 16 pp.

D-16060 *The Game of Science* (Santa Monica: The Rand Corporation, P-3182, July 1965). T. A. Cowan. July 1965.
Not abstracted; reviewed in R-732-AEPA.

D-16061 *Academic Games and Learning* (Baltimore, Maryland: Johns Hopkins University, Invitational Conference on Testing Problems, October 28, 1967). J. S. Coleman. 1968.

In this concise, well-reasoned paper, the author argues that games can be used to aid the learning process by helping to clarify the nature of the learning process itself. That is to say, games help to embed into experience and cognition the structure of social action on which the human sciences are based' (p. 75). The standard communication of factual information, well known to most students, is criticized as providing insufficient motivation and reinforcement of newly learned ideas through action in some context. In general, the author is arguing for a major rethinking of conventional teaching methods and suggests that games might be a useful alternative to consider first. 8 pp.

D-16062 'A Method for Applying Statistical Decision Theory to System Task Analysis,' *Human Factors*, Vol. 7, (1965), pp. 507-510. A. S. Cooperband, L. T. Alexander. 1965.

For system tasks involving signal detection, a method is presented by which statistical decision theory can be used to derive limiting conditions for adequate operator performance from results obtained in an abstracted laboratory task. The limiting conditions can then serve as a basis for making design decisions regarding functions allocation and for specifying operating rules. As illustrated, the method is applied to a collision-prediction task on which previous research suggested that performance depends on the ability to detect a nonzero rate of change in the relative bearing between the two objects moving on converging paths. 5 pp.

D-16063 'Continuity of Leadership in Communication Networks,' *Human Relations*, Vol. 14, No. 4 (1961), pp. 351-367. A. M. Cohen, W. C. Bennis. 1961.

The authors explore what happens to communication networks under various experimental conditions. The types of patterns studied include the wheel, chain, and circle. Results: if groups went from the wheel to the circle, they would then generally go to the chain. The leaders also would change. There was more stability of leadership when leaders were elected. 15 pp.

D-16064 'Political Gaming in the Classroom,' *Journal of Polities*, Vol. 24 (1962), pp. 367-381. B. C. Cohen. 1962.

Describes various forms of simulation that are being developed in political science; emphasis is given to 'reality' games in which players take the part of real-life decisionmakers in particular countries, working their way through the solution of realistic problems. 14 pp.

D-16065 'Effect of Group Cohesiveness and Training Upon Creative Thinking,' *Journal of Applied Psychology*, Vol. 44, No. 5 (1960), pp. 319-322. D. Cohen, J. W. Whitmyre, W. H. Funk. 1960.

Variables of training and ego-involvement were studied in cohesive, non-cohesive, and 'nominal' groups of two members each, based on sociometric choice. Results: only on ego-involving problems were there significant differences among the groups and then only in the number of unique ideas produced. The cohesive-trained groups were significantly better than all other groups. No significant differences were observed between the trained and untrained noncohesive groups. Sociometric choices for brainstorming partners were significantly related to the subjects' perceptions of their own skill. 4 pp.

D-16066 'Management Games, Information Processing, and Control,' *Management International*, Vol. 3 (1963), pp. 159-187. K. J. Cohen, M. H. Miller. 1963.

Training in decisionmaking cannot produce the 'complete' executive, and the concentration on such training in business gaming cannot be justified. Business games should also include training in information processing and implementation of decisions. Other improvements are suggested. 28 pp.

D-16067 'Amount of Reward and Information in a Two-Person Game,' *Canadian Journal of Psychology*, Vol. 18, No. 3 (1964), pp. 197-208. M. Cole, A. Schneider. 1964.

Subjects were allowed to compete for points in a payoff box. The amount

was varied by manipulating the magnitude of the payoff. At times information about the opponent's payoff was held back. Results: players with more favorable payoffs remained stable, choosing one alternative 60-65 percent of the time. Players with the smallest payoff varied most. 11 pp.

D-16068 'The Propensity to Attack Others as a Function of the Distribution of Resources in a Three Person Game,' *Psychonomic Science*, Vol. 9, No. 4 (1967), pp. 239-240. S. G. Cole, J. L. Phillips. 1967.

Hypothesis: an apparently strong person would be disadvantaged in a 3-person game in which coalitions are possible. This hypothesis was tested by use of a modified version of a truel that permitted close interpersonal contact prior to formation of a coalition. The test was run under three conditions. Result: the hypothesis was confirmed in all conditions. 2 pp.

D-16069 'Academic Games and Learning,' *National Association of Secondary School Principals Bulletin*, Vol. 52 (February 1968), pp. 62-72. J. S. Coleman. February 1968.

A discussion of academic simulation games, their goals and the means of accomplishing them. Conclusions: (1) the use of games fundamentally changes the process by which learning takes place, (2) the use of games in learning fundamentally changes the nature of the task that schools perform, and (3) simulation games are especially appropriate for embedding in students' experience and cognition the structure of social action on which the human sciences are based. 10 pp.

D-16070 *Simulation in the Study of Politics* (Chicago: Markham, 1968). Edited by W. D. Coplin. 1968.

Articles on the application of simulation to the study of international relations, municipal budgeting, METRO etc., by a number of political scientists then working on simulation projects.

D-16071 'Experience as a Factor in Experimental Gaming Behavior,' *Journal of Conflict Resolution*, Vol. 14 (June 1970), pp. 195-202. D. W. Conrath. June 1970.

It is hypothesized that a period of reflection on the environment increases the probability that a subject will behave in a 'jointly rational' manner. He may thus learn behavior appropriate for the maximization of joint utility, and may discover that certain behavior is necessary for individual maximization of expected utility in particular conflict environment. Many independent variables undoubtedly influence the rate at which the two experience effects occur. The nature of interpersonal communication, the size of the decisionmaking group, the complexity of the environment, and the availability of information about the environment all affect the rate and kind of learning. Precisely how they affect it, however, is not obvious. Finally, we need to learn more about the interplay between experience and 'trust' in conflict environments. Trust appears to be well substantiated as an element in conflict resolution, but how trust is established is another matter. From the evidence presented, it seems that detachment enhances trust. The extent to which it does is worth further investigation. 7 pp.

D-16072 *M.E.T.R.O.-APEX: A General Description* (Ann Arbor: Environmental Simulation Laboratory, December 1969). A. E. Cochran. December 1969.

This manual is a revised and condensed version of the author's unpublished master's thesis. APEX, the Air Pollution Exercise, is a man-machine, teaching and training game derived from the earlier M.E.T.R.O. urban planning game of Richard Duke and his associates (see D-23004, below). Comprehensive and thorough, this manual explains much about the game's hypothetical environment, players and typical styles of play, but not its underlying theoretical structures. APEX is currently being used at the University of Southern California to train prospective air pollution control officers for the National Air Pollution Control Administration, its prime sponsor. 59 pp.

D-16073 'Some Tactical Problems in Digital Simulation,' *Management Science*, Vol. 10, No. 1 (October 1963), pp. 47-61. R. W. Conway. 1963.

A study of the conduct of investigations using simulated experimentation after the model has been formulated and the computer program completed. It considers the problem of estimating the precision of the results and means of improving that precision. It is one of the earliest treatments of the specific problems of validation in digital simulation. The author begins with the pessimistic statement, 'I believe that in general simulation models take longer to construct, require much more computer time to execute, and yield

much less information than their authors expected.' He focuses on the phase in which one determines how to execute the experiment, addressing the problems of equilibrium and variability and sample size. The first refers to the time-consuming need often to run a simulation model extensively before it reaches a state worth investigating. To remedy that problem, one should choose starting conditions that exclude some data from the initial period but that minimize the excluded interval. As regards variability, sample size, and replication, simulation is thought to produce relative results much more efficiently than absolute results. Conway recommends (1) continuous assessment rather than periodic sampling, (2) executing a single continuous run, achieving 'replication' by increasing the length of the run, (3) using the mean value, except in the initial stabilization period of the run, to estimate the two mean system state. It is not always the most efficient estimate, but it is simple, unbiased, and increases in efficiency the longer the run. 14 pp.

D-18321 'Simulation: The Construction and Use of Functioning Models in International Relations,' K. R. Hammond, ed., *The Psychology of Egon Brunswik* (New York: Holt, Rinehart, and Winston, 1966), p. 340-358. W. J. Crow, 1966.

This article attempts to link the epistemological efforts of Egon Brunswik with the attempts of Guetzkow and his colleagues to construct an 'Inter-Nation Simulation.' The basic line of thought is hampered by excessive and often incomprehensible jargon. The brief sketch of INS has been done better elsewhere (see D-35078). The philosophical arguments comprising the bulk of the paper have little utility to gamers. 18 pp.

D-18322 'A Study of Strategic Doctrines Using the Inter-Nation Simulation,' *The Journal of Conflict Resolution*, Vol. VII, No. 3 (September 1963), pp. 580-589. W. J. Crow, 1963.

A simple and straightforward description of the Inter-Nation Simulation (INS) and its use in teaching strategic principles. Beyond a few general remarks concerning a pilot study, no ease is made for or against application. 10 pp

D-18323 'Computer Simulation in Urban Research,' *Public Administration Review*, Vol. 28, No. 1 (January/February 1968), pp. 66-77. J. P. Crecine, January 1968.

A description of the use of computer simulation in urban research, including studies of voting behavior, decisionmaking, urban development and planning, and macro-micro models of the urban system. 11 pp.

D-18324 'An Investigation to Determine Effects of Simulation Training on Student Teaching Behavior,' *Education Technology*, Vol. 9, No. 10 (October 1969). D. R. Cruickshank, F. W. Broadbent, October 1969.

Compared with conventional teacher-training methods, simulation was shown to have a significant effect on increasing motivation and teacher interest but no measurable impact on effecting consistent and significant behavioral changes. The subjects were 80 student teachers randomly selected from the State University of New York at Brockport. Experimental controls were stringent, specifying random selection of four 20-member groups, two of which were trained with simulation techniques, and the remaining two with traditional techniques. Sex and grade-point average differences were not significant between the groups. The subjects were randomly assigned to teaching posts. The test problem was to 'handle the constantly disrupting child.' Evaluation was done by means of interviews, a questionnaire designed for the experiment, and a self-reporting instrument, the Perceived Problem Inventory (described in Stanley Dropkin and Marvin Taylor, 'Perceived Problems of Beginning Teachers and Related Factors,' *Journal of Teacher Education*, Vol. 14 (December 1964), pp. 384-390). Results showed strikingly that aside from the novelty and 'fun' aspects of simulation, conventional teacher-training methods would have provided equivalent training for the situation tested. 4 pp.

D-18325 *The Valid Use of Simulation Results* (La Jolla: Western Behavioral Sciences Institute, June 1965). W. J. Crow, R. C. Noel, 1965.

An investigation of the validity of attributing to nations the behavior of individuals and groups participating in a simulation. Simulation of a disguised but historically accurate situation was constructed to test the roles of (1) players' psychological attributes, (2) the social context in which they operate, and (3) the nature of the situation they confront in the outcome of a simulation. A two-hour personality test was administered to 1,124 subjects to determine their attitudes toward militarism, nationalism, and risk-taking.

Of that number, 384 were chosen to participate in three experiments to compare personal psychological attributes with situational elements. The experiments showed that personal attributes and the social context significantly affected the outcomes. This is an interesting study of validation, and is valuable in pointing out that before a game or simulation can be validated, the model and the purpose of validation must be specified. 29 pp.

D-19501 *Families of Models* (Santa Monica: The Rand Corporation, P-3198, 1965). N. C. Dalkey, August 1965.

A description of a family of models, STROP, STRIP and STRAP, that deal with the problem of strategic allocations. STROP is a highly aggregated, two-sided war game. STRIP is an intermediate two-sided war game. STRAP is a detailed plan generator. STROP is explained in some detail and an example shown with initial conditions, allocations, final conditions, and payoffs outlined. Problems of defining the payoff in a central nuclear war are discussed. An extension of STROP is being developed that will analyze the problem of allocating funds to force structures. 29 pp.

D-19502 *Games and Simulations* (Santa Monica: The Rand Corporation, P-2901, 1964). N. C. Dalkey, April 1964.

The author argues that game theory has a role, though more modest than initially thought, in military planning. Advantages to be gained from the game theoretic perspective include expanded attention spaces and the examination of numerous alternative solutions, the explicit inclusion of the basic two- (or many-) sidedness of military conflicts, and the opportunity for optimization. Most military situations are too complex to be dealt with fully by game theory, but they can at least be approached, through the processes of problem decomposition and partial analysis. Cited as examples are the STRIP, STRAP, and STROP family of models built at Rand in the 1960s. 17 pp.

D-19503 *Central Nuclear War Games* (Santa Monica: The Rand Corporation, P-3437, 1966). N. C. Dalkey, September 1966.

This paper, prepared for a NATO operations research conference, argues that the development of fully formulated nuclear war games is hampered by three basic difficulties: (1) payoffs are hard to define in nuclear war, (2) a criterion is hard to determine in a highly non-zero-sum setting, and (3) the inherent complexity of the game context prevents even marginally acceptable representation. The critical difference between nuclear and nonnuclear war (and war games) is that which distinguishes catastrophe from non-catastrophe. STROP, one of a family of nuclear war models constructed at Rand, is described in terms of how it overcomes the three difficulties. This is a brief introduction to the game and is insufficient for acquiring a thorough understanding. 11 pp.

D-19504 *Game Theory: A Nontechnical Introduction* (New York: Basic Books, 1970). M. D. Davis, 1970.

Not abstracted; reviewed in R-732-ARPA.

D-19505 'Solvable Nuclear War Models,' *Management Science*, Vol. 11, No. 9 (July 1965), pp. 783-791. N. C. Dalkey, July 1965.

This excellent article demonstrates well why mathematized game theory and more free-wheeling gaming enterprises have not been melded in many productive ways. The piece offers a solid proof of the existence of a stable, non-cooperative solution in a central nuclear war game. To attain these results, several strong assumptions have to be invoked: (1) each side in the two-person game shall exhibit increasing concern as critical levels of damage are approached; (2) non-negligible counterforce capabilities exist, and (3) a single weapon, single target, and single exchange only are allowed. The tradeoff between realism and analytic tractability is clearly made in favor of the latter. The difficulty is in returning to a real context with careful and pertinent insight. The article indicates the author's ability to shift back and forth between the two contexts; one wonders if less skilled or substantively knowledgeable persons could perform as well. 8 pp.

D-19506 'A Public Opinion Game,' *Public Opinion Quarterly*, Vol. 25 (Summer 1961), pp. 210-220. W. P. Davison, 1961.

Group affiliations exert an important effect on a person's opinions. When a person is under cross-pressure he can react in several ways: he may vacillate back and forth on the issue, he may tend toward the stronger pressure, or he may retreat to a 'no opinion' position. To understand how a person forms a considered opinion on a public issue, one must study the

process whereby he arrives at the position that will best serve his needs. The author's prime concern is with the teaching of opinion formation to college undergraduates. He argues that role-playing in a game context can help show how socioeconomic status, personal interests, primary group affiliation, secondary group membership, and other factors enter into opinion formation. While this game is an oversimplification of the opinion formation process, it does have utility. As a learning tool it brings out some of the forces that shape an opinion. As an empirical research tool the game provides an opportunity to make more direct observations about the interaction of pre-existing attitudes and interests, primary group pressures, and secondary group influences. The free-form gaming procedures are detailed sufficiently in the body of the paper that they could be reproduced by a knowledgeable instructor. Apparently the author's own experiences with the play of the game were positive. Some consideration of the technique's limitations is appended. The article stands up well with the passage of time and serves as a paradigm for the construction of easy, disposable, cheap classroom gaming exercises. (Originally published as Rand Corporation P-2042, July 1960). 11 pp.

D-19507 'Arms Control Simulation: The Search for an Acceptable Method,' *Journal of Conflict Resolution*, Vol. 7 (1963), pp. 590-602. R. H. Davis. 1963.

To study arms control as a distinct problem, the author surveys certain methodologies including individual and group planning, scenarios, crisis games, symbolic simulation, and environmental simulation. He concludes that for prediction and evaluation, none of the techniques is adequate. However, environmental simulation, e.g., the works of Guetzlow, Kennedy, and Chapman, does offer the researcher control possibilities that are worth exploring. Small, well-defined aspects of the arms control issue might be studied under laboratory or experimental conditions, but the general problem will most likely defy conventional analytic treatment. 12 pp.

D-19508 *The Decision Making Game: An Integrated Operations Management Simulation* (New York: Appleton-Century-Crofts, Meredith Corporation, 1969). B. R. Darden, W. H. Lucas. 1969.

Discussion of OPSIM, a game that simulates a business environment and requires decisionmaking. Decisions are evaluated by computer printouts of financial statements for each of the competing firms. The participant learns about the flow of cash, materials, labor, capital, and information in an industrial enterprise; the difference between direct and costing methods; the advantages of each method for decisionmaking. The text includes complete instructions for the game plus directions allowing the instructor to change important aspects of the decision environment.

D-19509 *STROP: A Strategic Planning Model* (Santa Monica: The Rand Corporation, RM-4817-PR, July 1966). N. C. Dalkey. July 1966.

This small, rapidly computable model of central nuclear war was developed to help the analyst evaluate quickly a large number of possible plans, each of which depends on the actions of the enemy. The game, coded for an IBM 7040-44, evaluates a pair of Red and Blue allocations of missiles and bombers to some combination of four target systems: missile sites, bomber fields, bomber defenses, and value targets. One pair of Red and Blue allocations can be evaluated in about 1/50 second. Although the model is basically static, time enters into STROP in determining the average number of bombers or missiles at risk during enemy attack; in assessing the effect of warning and relative execute times; and in assessing the effect of rate of fire, a capability that can also be used to take into account the results of withholding portions of the forces for later attack. The outcome of nuclear exchange can be evaluated if the attacks on both sides are completely preplanned, or if one or both sides have a retargeting capability to compensate for losses to enemy fire. STROP distinguishes between value targets and military targets. In addition to exploring strategic plans, it can be used to evaluate force mixes. 51 pp.

D-20521 *Political-Military Scenarios* (Santa Monica: The Rand Corporation, P-3535, 1967). H. A. DeWeerd. February 1967.

The article is a good short lesson in writing scenarios. The author gives a brief history of political-military scenarios, which can serve variously as background contexts, settings for war games, and narratives of war games. To be effective the scenario should be modeled as closely as possible on the existing world; changes from this world should be explained as completely as possible. Two problems with scenarios, credibility and relevance, are

discussed. In some cases relevance, rather than credibility, should predominate; otherwise future problems cannot be studied. The problem of the player's reaction to the scenario is handled and suggestions are given to avoid the problem. 14 pp.

D-20522 *An Israeli Scenario for a Laboratory Simulation* (Santa Monica: System Development Corporation, SP-3139, March 1968). H. A. DeWeerd. March 1968.

This is an excellent political-diplomatic-military scenario in which world events are hypothesized for 1968-1973. First, the author describes the work of SDC's laboratory simulations in general. Then, for this scenario, assumptions about world events for the future five-year period are listed, and the hypothesized situations in Europe, the Far East, Soviet Union, United States, and the Middle East are described in some detail. Looking at the scenario several years later, one is impressed with how many of the hypothesized events have actually occurred. This, plus the scenario's conciseness and plausibility, points up the benefits of using the work of a master scenarioist. 7 pp.

D-20523 'Trust and Suspicion,' *Journal of Conflict Resolution*, Vol. 2 (1958), pp. 265-279. M. Deutsch. 1958.

Description of a game theory matrix used in a task with built-in interpersonal obstacles. Three motivational orientations were given: (1) cooperative, (2) individualistic, (3) competitive. Subjects receiving cooperative instructions performed the task best. 14 pp.

D-20524 'Some Effects on Business Gaming of Previous Quasi-T-Group Affiliations,' *Journal of Applied Psychology*, Vol. 51, No. 5 (1967), pp. 426-431. S. D. Deep, B. M. Bass, J. A. Vaughan. 1967.

Using the Carnegie Tech Management Game as an experimental vehicle, the authors assigned 93 graduate students in business to nine 'companies' according to whether they had been in the same or different T-groups in the previous 15-week academic period. The companies composed of players who were separated from their T-group colleagues performed more effectively than those whose T-group was left intact. The latter reported less internal conflict but were less effective in playing the game. It is speculated that the loss of effectiveness derived from overconfidence in the other players' dependability. This is an interesting use of games, psychological theory, and a currently popular training technique. 6 pp.

D-21081 *Proceedings of the Conference on Business Games*, Sponsored by The Ford Foundation, Tulane University, April 1961. W. R. Dill, J. R. Jackson, J. W. Sweeney. April 1961.

This small book records the work of 25 participants at a conference sponsored by the Ford Foundation in 1961. The discussion papers are generally very brief and vary in quality. Several provide a background for the Carnegie Tech Management Game. A chapter on the future of games in business education anticipates quite well what has happened since 1961, though it overlooked the influence of time-sharing and the problems of mass data processing.

D-22421 *A Sampling Inspection Problem in Arms Control Agreements: A Game Theoretic Analysis* (Santa Monica: The Rand Corporation, RM-2972-ARPA, 1962). M. V. Dresher. February 1962.

Many disarmament or arms-control agreements can be monitored by sample inspections. Unlike the usual sampling procedures, sampling for arms-control agreements must take into account the possibility that the statistical universe from which samples are to be drawn may have been tampered with so as to decrease the probability of detection of a violation. In this report the author formulates a game-theoretic model for studying a sampling problem in which the inspector is allowed to examine a fixed (usually small) number of items or natural events (e.g., items for an assembly line under an agreement limiting military production, or seismic events under a nuclear test-ban agreement). It is assumed that the inspections are to be performed within a fixed time period or on a series of events of fixed length. Optimal sampling procedures are derived as functions of the number of inspections and the size of the statistical universe. Some variations on the model are briefly considered. 29 pp.

D-22422 *Games of Strategy: Theory and Applications* (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1961). M. V. Dresher. 1961.

Not abstracted; reviewed in R-732-ARPA.

D-22423 *Some Military Applications of the Theory of Games* (Santa Monica: The Rand Corporation, P-1849, December 1959). M. V. Dresher. 1959.

Many military problems are concerned with how best to allocate forces in space and time under conditions of conflict. This monograph discusses the use of games to arrive at the optimal allocation of forces in strategic air war, tactical air war, and target prediction. In the case of strategic air war, the important problem of choosing targets for attack and defense is formulated both as a finite game and an infinite game. In the tactical air war game, the pursuit of a given theatre mission is portrayed as a series of strikes, or moves, each of which consists of simultaneous counter-air, air-defense, and close-support operations by both sides. Finally, as an example of target prediction, the problem of scheduling the launching of missiles is described and optimal launching schedules are suggested for both sides. 15 pp.

D-22424 'Realism in Laboratory Simulation: Myth or Method?' *Social Forces*, Vol. 45 (1967), pp. 337-346. T. E. Drabek, J. E. Haas. 1967.

This article simultaneously teases and frustrates the reader. The question it asks--'What determines whether an experiment is realistic or not?' is good, but the authors never come to grips with it. The useful part of the article is its lengthy bibliography and footnotes. 9 pp.

D-23001 'Gaming Urban Systems,' *Planning* 1965, pp. 293-300. R. D. Duke. 1965.

The article summarizes remarks made at the 1965 annual meeting of the American Society of Planning Officials. It is discursive and mildly advocacy in tone. The author advocates more free-form gaming to offset game theory's limitation in representing the real world. The author's own METROPOLIS game is briefly described. 8 pp.

D-23002 'An Experimental Approach to the Theory of the Firm,' *The Economic Record* (Journal of the Economic Society of Australia and New Zealand) (December 1961). N. F. Duffy. December 1961.

A description of a duopoly game played by two teams of six players drawn from junior or middle-rank executives. The price and inventories were control variables. Other relevant literature is listed. 6 pp.

D-23003 *Tarlog: A Differential Ground Combat Model* (Santa Monica: The Rand Corporation, P-3301, February 1966). E. P. Durbin. February 1966.

Discussion of the development of a family of differential combat models. The current model of the family, Tarlog, is described, and suggestions are given for improvements based on insights gained in experiments. The author notes that Tarlog represents a step forward in the attempt to describe the essential elements and interactions of units in large-scale land combat. 17 pp.

D-23004 *M.E.T.R.O., A Gaming Simulation: Toward a New Science of Urban Planning* (Lansing, Michigan: Tri-County Regional Planning Commission, Technical Report #5, January 1966). R. D. Duke. 1966.

A technical summary of the Michigan Effectuation, Training, and Research Operation urban planning game. It provides sufficient information to give the flavor of the game, but it is insufficient to evaluate, set up, or run the game. Topics discussed are the sequencing of the model, including its various subsections, common player interactions, flow charts of model processes, and some of the input forms used. Particularly disturbing is the lack of information on just what mysterious mechanisms churn out the results for each run. One simply has no way of determining what are the empirical and theoretical bases of the operation. 70 pp.

D-23961 *Optimum Evasion versus Systematic Search* (Santa Monica: The Rand Corporation, RM-3582-ARPA, 1963.) B. Efron. April 1963.

The solution of the following hide-and-seek game is presented: At each move Player I, the evader, is allowed to hide in one room, while Player II, the searcher, is allowed to search a given number of rooms. Player II must search without repetition, that is, he is never allowed to return to a room he has previously searched. It is shown that if the payoff to Player I is an increasing function of the number of moves before capture, his best strategy is never to return to a room in which he has previously hidden. A formula for the value of the game is presented. 13 pp.

D-24301 'The Contextual Study: A Structured Approach to the Study of Political and Military Aspects of Limited War,' *Operations Research*, Vol. 8 (September-October 1960), pp. 639-651. J. W. Ellis, T. E. Greene. September-October 1960.

The ever-present, hard-to-quantify, political aspects of a complex decision sequence are addressed explicitly in this article. Contextual studies are problem-solving activities based on feedback and successive approximation of the real world. Attention is directed to the choice points, alternative decision rules, or 'processes' thought to be underlying or operating in a context. Each choice is specified, documented, and justified using political criteria. Analytic structure is obtained by use of map and time-sequence constraints. Weaknesses of the approach are discussed briefly. 12 pp.

D-24801 *A Simulation Game for the Study of State Policies* (Middletown, Conn.: The Institute for the Future, R-9, September 1969). S. Enzer, T. J. Gordon, R. Rochberg, R. Buchele. 1969.

This account of activities at the Institute for the Future (IFF) in Middletown, Connecticut, describes the Connecticut Game, a game devised for the Connecticut Research Commission that combines forecasting, cross-impact matrix studies (and other methodological topics), polities, and state and local governmental and development processes. For two days in June 1969, twenty participants from various agencies of the Connecticut state government played the game, in which the effects of various hypothesized, plausible events in government policy and society were simulated for the state in the decades of the '70s and '80s. The game is free-form and is supplemented by some light bookkeeping and information display. Though the game as played neither forecast significantly nor suggested precise effects of the alternative policies (pp. 4, 30-32), the authors claim that the game is useful as an educational and communication tool in systematically considering public issues and alternative policies. It is very difficult to assess free-form gaming activities. At the least, it is a promising and relatively inexpensive analytic device. 69 pp.

D-24802 *Logistics Laboratory Problem I After Two (Simulated) Years* (Santa Monica: The Rand Corporation, RM-1993, October 1957). S. Enke. October 1957.

Rand's Logistics Systems Laboratory began the floor run of Laboratory Problem I in its first year of operation, on July 22, 1957. This exercise was designed (1) to test a promising set of logistics policies and procedures for operational feasibility, and (2) to compare its performance against another set of policies based on recent and current Air Force practice. Laboratory Problem I compressed five years of experience into about five months of laboratory time. Though the experiment had not concluded when this report was written, results to date showed that, after the two systems had flown the same number of hours, the experimental Logistics System II had fewer AOPC's, about the same AOCM's, and more ANFE's than the traditional Logistics System I, and Logistics System II was considerably less costly, with expenditures for aircraft spares almost 50 percent less than those for Logistics System I. 24 pp.

D-26501 *Games Ancient and Oriental and How to Play Them* (New York: Dover Publications, 1961). E. Falkener. 1961.

Not abstracted; reviewed in R-732-ARPA.

D-26502 *A Simulation Model of Decision Making in a Management Game* (Master's thesis, University of California, Los Angeles, 1971). W. C. Farrell. 1971.

This paper describes a cognitive-process model of a person playing a business game. It is based on the postulates of an information-processing theory of human problem-solving. Protocols were taken of the subject as he learned the rules of the game in order to determine his initial concept of the problem. The concept of par in business games is defined as 'good to excellent line of play, which results in satisfactory (but not perfect) utilization of the resources.' 124 pp.

D-26916 *Data Analysis in a Business Game* (New Haven: Yale University, Technical Report No. 8, 1970). P. Feder, G. Wolf. 1970.

This report describes efforts to analyze some data generated by a monopoly game. The scenario within which the data were generated is described by the instructions: 'You may view yourself as taking over control of a corporation about which you have relatively little information. From the brief market, production and financial figures, during the course of preparation,

you will need to form a picture of the market and your cost.' The players were not particularly skilled in economics. The results were in many ways unsatisfactory but they do point up the relationship between psychological and economic variables.

D-26917 'Operational Gaming in Planning Education,' *Journal of the American Institute of Planners*, Vol. 32, No. 1 (January 1966), pp. 17-23. A. G. Feldt. January 1966.

General description of Cornell Land Use Game (CLUG), concentrating on the rules of the game and the behavior of the players rather than on roles. Feldt believes such games should be used only as teaching and communication devices.

D-27401 *Cost Considerations in Systems Analysis* (New York: American Elsevier, 1971). G. H. Fisher. 1971.

This is a far too brief and elliptical description of what could be an extremely important form of gaming. The idea of a time-shared data base and analytical programs is well developed, although the distorting influence of bureaucracy is not mentioned. A longer and more explicit treatment of X-RAY is called for. 334 pp.

D-27403 'The Analysis of Simulation Generated Time Series,' *Management Science*, Vol. 13, No. 7 (March 1967), pp. 525-557. G. S. Fishman, P. J. Kiviat. 1967.

A good, clear exposition of a neglected topic. It applies spectral analysis to the investigation of time-series data generated by simulated stochastic models. An heuristic background for understanding statistical spectral analysis is presented, and three simulated experiments are used as examples of how to apply the technique. As simulation data are generally autocorrelated, one cannot apply common statistical tools used to study independent observations. Salient time properties of autocorrelated processes can be studied by spectral analysis in a way that is easily interpretable for both descriptive and comparative purposes. When studying the stochastic process, one is usually interested in both the average level of an activity and deviations from that level. The duration of these deviations may also be of interest because autocorrelation commonly leads to overestimations of the reliability of both sample means and variances. To illustrate the technique, the authors simulate a simple, single-server queueing model having Poisson arrivals, exponentially distributed or constant service time, and a first-come, first-served (or shortest-operation) rule for job assignment to a queue. Differences in statistical properties of items, such as queue length, are identifiable using spectral analysis. More generally, this estimation procedure provides a tool for comparing simulated time series with real-world data and for understanding the implications of alternative assumptions for the output of simulated stochastic models. 32 pp.

D-27404 *Digital Computer Simulation: Statistical Considerations* (Santa Monica: The Rand Corporation, RM-5387-PR, November 1967). G. S. Fishman, P. J. Kiviat. 1967.

A discussion of the statistical problems that arise in computer simulation experiments. Three problem areas inherent in all stochastic system simulation models are discussed: verification, which determines whether a model actually behaves as an experimenter assumes it does; validation, which tests whether the model reasonably approximates a real system; and problem analysis, which seeks to ensure proper execution of a simulation and proper handling of its results. The study traces the elements of a simulation experiment from initial conception to analysis of final results, defining the statistical problems that arise at each step and relating them to the formal body of statistical theory. Since the aim is to promote awareness of problems, not to solve them, the study offers no general solutions but provides references germane to the statistical problems described. 41 pp.

D-27405 'Estimating Sample Size in Computing Simulation Experiments,' *Management Science*, Vol. 18, No. 1 (September 1971), pp. 21-38. G. S. Fishman. 1971.

A method is described for estimating and collecting the sample size needed to estimate the mean of a process (with a specified level of statistical precision) in a simulation experiment. Steps are also discussed for incorporating the determination and collection of the sample size into a computer library routine that can be called by the ongoing simulation program. The authors present the underlying probability model that enables denotation of the variance of the sample mean as a function of the autoregressive representa-

tion of the process under study. They also describe the estimation and testing of the parameters of the autoregressive representation in a way that can easily be 'built into' a computer program. Several reliability criteria are discussed for use in determining sample size. Since these criteria assume that the variance of the sample mean is known, an adjustment is necessary to account for the substitution of an estimate for this variance. It is suggested that Student's distribution be used as the sampling distribution, with 'equivalent degrees of freedom' determined by analogy with a sequence of independent observations. 18 pp.

D-28051 'Some Experimental Games,' *Management Science*, Vol. 5, No. 1 (October 1958), pp. 5-26. M. M. Flood. October 1958.

This paper reports the results of six informal experiments to assess the applicability of non-constant-sum games run in 1952. The incidents involved bargaining for the sale of a car, running a reverse auction for a job, and running a fair division procedure to distribute some goods. They were all conducted on an extremely informal level, except for one game, without communication, which was run for 100 trials. The author uses his experience with these games to discuss some of the problems of the application of n-person non-constant-sum game theory. In spite of the informality of the games, the paper is provocative and extremely useful. It represents one of the earliest attempts to relate game-theoretic concepts to actual bargaining and fair division. 22 pp.

D-28052 'Simulation Studies of International Conflict,' *Simulation*, Vol. 14, No. 4 (April 1970), pp. 181-184. A. Flook. 1970.

A succinct, careful evaluation of the use of models such as ING and the Goldhamer Game in the study of international relations. Neither optimistic nor pessimistic, it raises the appropriate questions about what is meant by validation. 4 pp.

D-28053 'Game Learning Theory and Some Decision-Making Experiments,' in R. M. Thrall, C. H. Coombs and R. L. Davis (eds.), *Decision Processes* (New York: John Wiley and Sons, 1954). M. M. Flood. 1954.

Cited; not abstracted; not reviewed.

D-28054 *A Preference Experiment* (Santa Monica: The Rand Corporation, P-256, November 1951). M. M. Flood. November 1951.

'A group of individuals is asked to select one from a set of alternatives. The experiment is arranged so that each individual has a strong incentive to guide the group selection toward the alternative he prefers. The first member of the group to announce a selection commits the group by his act.' This experiment was conducted to gain insight into the organization, administration, and analysis of other preference experiments and to find an experimental form that would permit testing a variety of mathematical theories of social organization. The report reproduces an experiment conducted at Harvard University, including documentation, conversation of the group during play, and the results of the play. 43 pp.

D-28351 *World Dynamics* (Cambridge, Mass.: Wright-Allen Press, Inc., 1971). J. W. Forrester. 1971.

Not abstracted; reviewed in R-732-ARPA.

D-28352 'Industrial Dynamics--After the First Decade,' *Management Science*, Vol. 14, No. 7 (March 1968), pp. 398-415. J. W. Forrester. 1968.

An assertion that industrial dynamics, described as the application of feedback concepts to social systems, is evolving toward a theory of structure in systems while remaining an approach to corporate policy and design. The case is not well supported or persuasive. 18 pp.

D-28353 'Industrial Dynamics--A Response to Ansoff and Slevin,' *Management Science*, Vol. 14, No. 9 (May 1968), pp. 600-618. J. W. Forrester. 1968.

The author asserts the importance of industrial dynamics as a new theoretical way of viewing organizations and restates his philosophy concerning modeling, validation, and information gathering. 19 pp.

D-28896 'The Behavioral Science Laboratories at Purdue's Krannert School,' *Administrative Science Quarterly*, Vol. 14, No. 2 (June 1969), pp. 171-177. H. L. Fromkin. 1969.

The behavioral sciences laboratories were designed to facilitate experimental research ranging from studies of individual-choice behavior to studies of

organizational processes and the large-scale simulation of international political conflict. Electronic equipment was selected to minimize the need for special instruments for single experiments and to reduce the number of experiments occupying laboratory space on a semi-permanent basis. The complex consists of an individual-behavior laboratory, a small-group behavior laboratory, and a large-group behavior laboratory. They occupy three distinct areas of 2900 square feet, and an adjacent 1000 square feet of space is used for offices and waiting rooms. The electronic and acoustical design permits small rooms to be used independently. Electronic equipment consists of a manually controlled system serving the small- and large-group labs and a separate, automated facility for individual-behavior labs. They are interfaced with cable trunkage, which enables the transmission of auditory and visual signals between the two systems. Each of the group labs is fitted with jacks for ceiling and wall microphones and closed-circuit television camera; mounts for remote-control cameras; a closed-circuit video monitor; recessed ceiling speakers; a substation remote-control console; and furniture that can be stored under the observation deck. Approximately 500 communication links and equipment activities are available for control. The individual-behavior lab is designed to automatically control the presentation or exchange of auditory and visual information among the experimenter, 12 subject booths, and the control station. Each booth has a closed-circuit television camera with zoom lens, a 9-in. closed-circuit video monitor, a digital display, two signal lights, a combination earphone and microphone headset, and 8 lighted pushbuttons recessed in the table. 7 pp.

D-2897 'A Developmental Examination of Performance in a Tacit Coordination Game Situation,' *Journal of Personality and Social Psychology*, Vol. 5, No. 3 (1967), pp. 277-281. C. L. Fry. 1967.

The tacit coordination game performances of 24 fourth graders and 24 eighth graders were compared with college controls. Subjects played three 2-person, 3-choice games with several like-aged partners from different ascendance quartiles. The game required subjects to repeatedly anticipate the object choice of a partner and provided increasing information for doing so. College subjects outperformed eighth graders, who outperformed fourth graders (p 's less than .001). College and eighth-grade subjects improved with successive partners (p 's less than .06, .001). The pattern and object convergence strategies found in the college subjects were less evident in eighth graders and were absent in fourth graders. Differences between partners' ascendance scores predicted game success in college and eighth-grade subjects only. 5 pp.

D-2931 *Buckminster Fuller Presentations to Congress: The World Game* (Carbondale, Illinois: Southern Illinois University, 1970, mimeo). B. Fuller. 1970.

Not abstracted; reviewed in R-732-ARPA.

D-2932 'Human Factors Engineering: A Potential Personnel Management Tool,' *Air University Review*, Vol. 22, No. 4 (May-June 1971), pp. 66-69. D. S. Fujii. June 1971.

Addressing a well-known problem, the author argues that through the use of human-factors engineering, personnel may be encouraged to stay in the armed services. He shows how considerable savings in training costs were realized by the judicious use of human grouping principles, human-engineered visual displays, and human-centered design principles in the design of the Air Force Satellite Control Facility. While the article does not have high merit, the topic is ideally suited to gaming treatment. 5 pp.

D-2933 'A Tactical Air Game,' *Operations Research*, Vol. 5 (1957), pp. 704-712. D. R. Fulkerson, S. M. Johnson. 1957.

A discrete, linear model of a tactical air war is formulated as a multi-move game. The symmetric case, in which the attrition rates are the same for both sides, is solved for both finite and infinite campaigns. Examples and interpretations of the results conclude the article. This is an elegant and quite difficult piece of work that nonetheless can be read and understood by someone with minimal mathematical training. 9 pp.

D-29501 *Baselogs--A Base Logistics Management Game* (Santa Monica: The Rand Corporation, RM-2086, January 1958). L. Gainen, R. A. Levine, W. H. McGlothlin. January 1958.

A description of the game Baselogs, which was developed by Rand's Logistics Department to demonstrate the interaction between logistics and operations on a fighter-interceptor air base of the ADC type. 17 pp.

D-29502 'Cooperative and Competitive Behavior in Mixed-Motive Games,' *Journal of Conflict Resolution*, Vol. 9, No. 1 (March 1965), pp. 68-78. P. S. Gallo, C. G. McClintock. 1965.

A survey of experiments on cooperative and competitive behavior in mixed-motive games. Little theoretical explanation is given. 10 pp.

D-29503 'A Theory of Coalition Formation,' *American Sociological Review*, Vol. 26 (1961), pp. 373-382. W. A. Gamson. 1961.

Coalition formation is a pervasive aspect of social life. This paper presents a theory of coalition formation with a statement of conditions and assumptions. While applicable to groups of varying sizes, it is shown to be consistent with Caplow's theory of coalitions in the triad. It successfully handles the experimental results of Vinacke and Arkoff. Finally, the applicability of various work in n-person game theory is discussed with the conclusion that, in its present state, it fails to provide a basis for a descriptive theory of coalitions. 10 pp.

D-30431 *Man-Machine Simulation Experience* (Santa Monica: The Rand Corporation, P-3214, 1965). M. A. Geisler, A. S. Ginsberg. August 1965.

A general discussion of the man-machine simulation technique. It distinguishes games, game simulations, and all-computer simulations. Situations are examined where the game-simulation technique is preferable to other systems analysis techniques. Game simulations conducted at Rand's Logistics Simulation Laboratory are explored in some detail. 23 pp.

D-30432 *Rand's Role in Logistics Systems* (Santa Monica: The Rand Corporation, P-3329, 1966). M. A. Geisler. March 1966.

A discussion of the impact Rand's logistics systems work has had on the Air Force. One study, the systems approach to base stockage, is outlined, and successful tests of the technique are presented. The author provides a glimpse of an organization that was an early leader in the gaming and simulation techniques. No substantive gaming work is presented. 12 pp.

D-30433 *A First Experiment in Logistics System Simulation* (Santa Monica: The Rand Corporation, P-1415, 1959). M. A. Geisler. July 1959.

The paper discusses the activities of the Rand Logistics Systems Laboratory during its first year of operation, when the lab tested a series of proposed changes in the Air Force supply system. The test consisted of comparing a simulated 1956 AF system with that system modified to reflect the proposed supply policies. The experiment indicated that the logistics system containing the newer supply policies was a better system according to the criterion established. At the same time, the experiment did highlight the difficulty of testing logistics policies under even the idealized conditions of the lab and the problems of interpreting experimental findings. 47 pp.

D-30434 'The Simulation of a Large-Scale Military Activity,' *Management Science*, Vol. 5, No. 4 (July 1959), pp. 359-368. M. A. Geisler. 1959.

A concise, general description of mid-project activities at Rand's Logistics Simulation Laboratory (LSL). The discussion of Laboratory Problem-I notes that the exercise was intended to test alternative logistics policies for the Air Force, to integrate existing research with operational requirements, and to develop man-machine laboratory techniques and facilities. The author notes the LSL enterprise raises the question of the personnel requirements for conducting serious system simulation. LSL, whose work extended over several years, had 30 professionals and about 20 support staff, rather elaborate laboratory facilities, and adequate computational support. 9 pp.

D-30435 *Simulation and the Logistics Systems Laboratory* (Santa Monica: The Rand Corporation, RM-3281-PR, September 1962). M. A. Geisler, W. W. Haythorn, W. A. Steger. 1962.

A comparison of a game-simulation technique, developed at Rand and used extensively in the Logistics Systems Laboratory, with other simulation techniques. The use of the Rand technique in logistics research is described, and its advantages and disadvantages are discussed. 77 pp.

D-31121 *The Crisis Game: Simulating International Conflict* (New York: Doubleday, 1965). S. F. Giffen. 1965.

Not abstracted; reviewed in R-732-ARPA.

D-32021 'Some Observations on Political Gaming,' *World Politics*, Vol. 12 (1959), pp. 71-83. H. Goldhamer, H. Speier. 1959.

The article discusses the history of political gaming outside Rand and in the Rand Social Science Department. In the mid-fifties four games were played at Rand. The fourth and most extensive is discussed in detail. It was played by senior players and took one month full-time. The game was designed with minimal formalization, simulation of incomplete and incorrect information, simulation of contingent factors, plausibility of game events, clarification of issues, and the exploration of novel strategies. The game served to suggest research priorities for problems of which the authors were already aware. Its usefulness as an educational device was established for students of politics and for individuals with considerable political training and knowledge. The article also describes a political game played at M.I.T. in a graduate seminar on international communications. Although the rules were much simpler than the Rand game rules, the students were highly motivated and even continued the game during the recess. Future gaming experiments should look at variants such as time, tempo, replication, and variant strategies, predicted vs. optimal strategies, scope, political behavior, and international participation. 25 pp.

D-32022 *The Effect of Role-Playing in a Problem-Solving Situation* (Pittsburgh: Carnegie Institute of Technology, Graduate School of Industrial Administration, Reprint No. 196, 1964). M. M. Gold, A. C. Stedry. 1964.

A useful article about the consequences of assigning roles to players in experimental games. Whether leadership is allowed to emerge or is imposed from the outside would seem to make a difference in a game. But little work has been done to test this hypothesis. The authors report on an experiment they ran giving players different roles and different incentives. Their results were negative; in other words, no significant differences showed up. This may be an artifact in the experiment, and the authors justifiably urge more experimentation on the topic. They incidentally make the observation that the selection policy of scholarly journals is biased against reports of the careful replication of experiments. 24 pp

D-32023 *The Inter-Community Simulation: An Experiment in Simulation-Gaming* doctoral dissertation, University of California, Los Angeles, 1968. R. F. Goodman. 1968.

This is a competently constructed free-form game based upon inter-community politics in a small town. It was done primarily under the direction of Professor Marvin Hoffenberg at UCLA. The game itself is well documented, but the survey of simulation and gaming could have gained by being more constructively critical. 235 pp.

D-32024 'Man Against His Environment: A Game Theoretic Framework,' *Association of American Geographers: Annals*, Vol. 53 (1963), pp. 290-297. P. Gould. 1963.

A consideration of the application of game theory to the Ghanaian agricultural economy. It is contended that geographers may begin to think more rigorously in terms of competition for locations whose value depends upon the locational choices of others; or, perhaps more usefully, in terms of man choosing certain strategies to overcome or outwit his environment' (p. 290). One simple example considers what crop mixes are most suitable given nature's state in either a wet or a dry year. The implications of the 'solution' to this two-person, zero-sum game include asking how the theoretical and actual land uses (crop mixes) differ; if there is in fact a strong element of rational behavior underlying the behavior of Ghanaian, and by extension other, primitive, farmers; and what an advisor organization might learn and recommend from theoretical analyses. The second, more complicated, example determines appropriate marketing mixes for cattle under different conditions of rainfall. This is an effective illustration of yet another subject to which game theory is being usefully applied. 8 pp.

D-33616 *Business Simulation in Industrial and University Education* (Englewood Cliffs: Prentice Hall, 1962). P. S. Greenlaw, L. W. Herron, R. H. Rawdon. 1962.

This is a handy guidebook to business gaming and simulation. Besides showing how business games fit into the broader tradition of gaming, the authors consider the related problems of game design, administration, and execution. Major questions about validation and other 'big' questions are listed to remind the reader of the limitations of the methodology. A summary of prominent business games circa 1961 is appended.

D-33617 'Simulations, Games, and the Sociologist,' *The American Sociologist*, Vol. 6 (May 1971), pp. 161-164. C. S. Greenblatt. 1971.

Perhaps the author's only-recent introduction to simulation and games accounts for the meagerness of this article on games for educational purposes. The following games are touched on: the Cornell Land Use Game (CLUG); Democracy and Ghetto, two of James Coleman's many games; INS; and Starpower, by Garry Shirts, of the Western Behavioral Science Institute. 4 pp.

D-33619 *The Study of Coalition Behavior: Theoretical Perspectives and Cases from Four Continents* (New York: Holt, Rinehart & Winston, 1970). Edited by S. Greenblatt, E. W. Kelley, M. Leiserson. 1970.

Not abstracted; reviewed in R-732-ARPA.

D-33620 'Succession with an Ally,' *Administrative Science Quarterly*, Vol. 14, No. 2 (June 1969), pp. 155-170. O. Grusky. 1969.

Sixty business organizations were simulated in the laboratory to examine the effects of succession with and without an ally. The two most significant findings were (1) succession with an ally moderated the effects of formalization, which is a component of executive succession, and (2) succession of an executive with an ally greatly altered the formal structure of organizational authority. 16 pp.

D-35076 'Simulation in the Consolidation and Utilization of Knowledge About International Relations,' in D. G. Pruitt and R. C. Snyder, eds., *Theory and Research on the Causes of War* (Englewood Cliffs: Prentice Hall, 1969), pp. 284-300. H. Guetzkow. 1969.

Not abstracted; reviewed in R-732-ARPA.

D-35077 *Simulation in Social Science: Readings* (Englewood Cliffs: Prentice Hall, 1962). H. Guetzkow. 1962.

Not abstracted; reviewed in R-732-ARPA.

D-35078 *Simulation in International Relations: Developments for Research and Teaching* (Englewood Cliffs: Prentice Hall, 1963). H. Guetzkow, C. F. Alger, R. A. Brody, R. C. Noel, R. C. Snyder. 1963.

Not abstracted; reviewed in R-732-ARPA.

D-35501 *Simulated Economic Models* (Homewood, Illinois: R. D. Irwin, 1963). J. Haldi, H. M. Wagner. 1963.

Not abstracted; reviewed in R-732-ARPA

D-35502 *Perspectives on Public-Systems Gaming* (McLean, Virginia: Research Analysis Corporation, 1965). L. G. Hawkins, Jr. 1965.

Misinterpreting the purpose of analytic efforts in the San Francisco and Pittsburgh Community Programs (CRP), the author calls them 'games.' They are, rather, simulation models, having negligible or no interaction among participants. This article does little more than perpetuate commercially inspired and seemingly self-serving discussions about the programs. 13 pp.

D-35503 'A General Theory of Rational Behavior in Game Situations,' *Econometrica*, Vol. 34, No. 3 (July 1966), pp. 613-634. J. C. Harsanyi. July 1966.

The von Neumann-Morgenstern theory of games does not yield determinate solutions (corresponding to unique payoff vectors) for two-person variable-sum games and for n-person games. The present paper outlines a general theory of rational behavior in game situations that does yield determinate solutions for all classes of games. The theory is based on two classes of rationality postulates: those defining rational behavior as such, and those defining rational expectations concerning the other players' behavior. It is argued that this new approach greatly increases the applicability of game theory to economics and the other social sciences. 22 pp.

D-35504 *TEMPO Military Planning Game: Description and Discussion* (Santa Barbara: G.E.-TEMPO, May 1962). H. Hatry, F. Jackson, P. Lever. May 1962.

A description of the TEMPO Military Planning Game, whose stated purpose was to 'provide a pedagogical device which could excite interest and acceptance of specific methodological tools in sophisticated military force-structure long-range planning.' (p. 1) Neither the 2-page description nor the 4 pages of rules of play provide enough information to play the game or to

permit a critical scrutiny of it. The document in general seems intended, rather, to promote the enterprise and secure funding for it. 26 pp.

D-35505 'Group Problem Solving Effectiveness under Conditions of Pooling v. Interaction,' *The Journal of Social Psychology*, Vol. 59 (1963), pp. 147-157. E. J. Hall, J. S. Mouton, R. R. Black. 1963.

There are at least three schools of thought as to whether group decision processes are superior to individual processes. One school argues that group decisions are superior to individual because of the effects of pooling; a second holds that group superiority derives from interaction, which allows a joint product to emerge; and the third dismisses both the statistical and interactionist schools, contending that group decisions may at best be only a compromise of individual contributions. This imaginative experiment demonstrated that one can obtain a group score superior to that obtained by simple pooling; the pooled score is significantly inferior to that obtained through interaction; and group judgment approaches the best individual judgment rather than the worst, as might be expected. The experiment used 158 adult subjects ranging in age from 25 to 55, arranged in groups of six to eight members. The subjects viewed the film *Twelve Angry Men* and predicted the behavior of the 12 characters in the film, 'as a test of their understanding of social events against those actually occurring in the film' (p. 150). The study offers evidence that group judgment procedures do have some utility and that gaming techniques, particularly time-shared games, might be a fruitful vineyard to tend. 11 pp.

D-35506 'The Cornell Datalogger,' *Administrative Science Quarterly*, Vol. 14, No. 2 (June 1969), pp. 222-223. D. P. Hayes. 1969.

Description of a computer-oriented datalogging system designed to record events directly on computer tape. It is possible to record 100 independent sources of information for long-term monitoring of participation by group members. Conduction microphones worn on the forehead permit complete isolation of each subject's voice during conversations. The datalogger is directly linked to an IBM 1800 process computer. 2 pp.

D-37782 *A Use of Simulation for the Study of Future Values* (Santa Monica: The Rand Corporation, P-3443, 1966). O. Helmer. September 1966.

A brief description of the design of a simulation workshop conducted at the University of Pittsburgh on the effect of technological change on American values. The participants, divided into several groups, were asked '(a) to make decisions affecting the character of our environment, (b) to estimate the societal consequences of decisions, and (c) to evaluate the desirability of these consequences.' The purpose of the experiment was to take a critical look at the simulation technique as a tool for social planning of the future. This document identifies the participants, gives the rules, and describes and assesses the experiment. 36 pp.

D-37783 *An Approach to the Study of a Developing Economy by Operational Gaming* (Santa Monica: The Rand Corporation, P-2718, 1963). O. Helmer, E. S. Quade. March 1963.

A discussion of the use of operational gaming or simulation for studying the total economy of a developing country. Precise data and consistent economic theory do not exist for developing economies; therefore simulation is a useful technique since it relies on partly articulated and largely intuitive judgments by experts. The authors advocate the use of human participants because there are many hard-to-quantify social and political factors in an economic system that computer simulation cannot handle. Suggestions are given for designing a simulative game model to investigate economic problems on a national scale. In summary, the authors assert that the gaming technique permits the systematic tapping of the knowledge and insight of experts in diverse specialties and provides a means of taking into account intangible factors in the economic system. This article may be somewhat dated by now. 23 pp.

D-37784 *Political Analysis of the Future* (Middletown, Conn.: The Institute for the Future, P-1, 1969). O. Helmer. August 1969.

In this paper, prepared for the 1969 meetings of the American Political Science Association, Helmer recommends the use of the Delphi and Cross-Impact Matrix methodologies to study the future in five areas of national policy: (1) international political indicators, (2) national goals, (3) capitalism versus communism, (4) cost effectiveness of foreign policy, and (5) negotiations. While the author's unbridled enthusiasm for political forecasting

needs tempering, he is to be commended for having ventured into an intellectual vacuum. The gamier will be duly wary of Helmer's thesis that by gaming (particularly role-playing through scenarios) and other operations analysis techniques, the future can be foretold. 10 pp.

D-37785 *Magister Ludi* (New York: Holt, Rinehart and Winston, Inc., 1969). H. Hesse. 1969.

Not abstracted; reviewed in R-732-ARPA.

D-37786 'Systems Approach to City Planning,' *Harvard Business Review*, Vol. 44 (September 1966), pp. 71-80. C. C. Hermann. 1966.

A sales pitch for the model-building activities of Arthur D. Little Inc. for the San Francisco Community Renewal Program. As the author, a vice-president of ADL, did not play a substantive part in the design, construction, or attempted implementation of the model, this account is superficial and uncritical. 10 pp.

D-37787 *Decision in Battle: Breakpoint Hypotheses and Engagement Termination Data* (Santa Monica: The Rand Corporation, R-772-PR, June 1971). R. L. Helmbold. June 1971.

This is a first-rate, meticulous, critical examination of a central theoretical concept in war gaming and analysis: the breakpoint hypothesis. The breakpoint hypothesis is used to determine when and how to terminate simulated combat for war games, simulations, and analyses. Simply, it indicates at what level of casualties one side will give up a battle. Addressing the question of what constitutes win and loss in combat, the study finds that 'Until a better theoretical explanation of the battle termination process becomes available, the soundness of models of combat such as war games and computer simulations that make essential use of breakpoint hypotheses is suspect' (p. v). The author points out that the empirical evidence he collected for over 1000 different battles does not support the theoretical predictions of the breakpoint; that other variables besides casualty rates and levels have to be considered; and that actual battle is a dynamic decision process where one combatant relates to his opponent through time, not acting merely on the basis of absolute levels of casualties. A rigorous and thorough rethinking of an important, commonly used theoretical argument, this report includes an outline of what a proper theory must be capable of doing. A valuable bibliography is appended. 96 pp.

D-37788 'Validation Problems in Games and Simulations with Special Reference to Models of International Politics,' *Behavioral Science*, Vol. 12 (May 1967), pp. 216-231. C. F. Hermann. 1967.

Validation is an important, misunderstood, and frequently abused part of model design, construction, and operation. The author discusses several types of validity criteria to show that the validity of a game or simulation is intimately connected to its purpose. 'Internal validity' refers to the extent of between-model run invariance (with all significant aspects of the model held constant); 'face validity' is the subjective feeling that a model is producing plausible outcomes; 'variable-parameter validity' is the analysis of the sensitivity of a model's initial conditions and parameters; 'event validity,' the extent of correspondence between real phenomena and those produced by the model; and 'hypothesis validity,' the extent to which specified relationships in a model can be substantiated by systematic external analysis. Having human players further complicates the validation process. The author concludes, with respect specifically to political-diplomatic-military games, that 'Validation questions other than that of face validity, have yet to be explored for most operating models' (p. 230). He does not explain why that is so. This article is a fair, nontechnical summary of several validation issues for the layman. It does not satisfactorily resolve the issues it raises, however. For example, How is a sensitivity analysis done? Of what use is a model that has not been analyzed for sensitivity? What is the difference between specification, verification, and validation of a model? How does data validation differ from model validation? The technically inclined reader is referred to George S. Fishman and Philip J. Kiviat, *Digital Computer Simulation: Statistical Considerations* (Santa Monica: The Rand Corporation, RM-5387-PR, November 1967), for a more rigorous and competent treatment of these topics. 16 pp.

D-38931 *A Note on Evaluating Operational Gaming* (Santa Monica: System Development Corporation, SP-40, October 16, 1958). D. R. Hitchcock. 1958.

Distinctions between operational gaming for research, demonstration, and

teaching are made to suggest that different gaming purposes may demand different functional forms of games. It is argued convincingly that games for research may not be useful for advocacy or demonstration because the former are not intended to transmit or demonstrate information as much as to discover information. Likewise, a training game probably will not reveal much that is new or interesting about an environment because it is meant to teach principles or techniques that are already known. The author notes that because of professional respect among gamers, the scientific worth of a model or game is not generally questioned when used to demonstrate or advocate; '(A colleague) is not likely to question us as to our assumptions or research techniques.' It is presupposed that some professional standards underlie the message being advocated. One suspects, however, that such standards are in short supply and are not widely held and adhered to. 5 pp.

D-39466 'Measuring the Cooperativeness of Behavior in Quantity Variation Duopoly Games.' *Behavioral Science*, Vol. 12, No. 2 (March 1967). A. C. Hoggatt. March 1967.

An economic game involving two players was employed to create a laboratory market environment in which there were elements of cooperation and competition. Paper profits (scores) were received by the players in repeated play of a game that can be defined as a non-zero-sum, two-person game with no preplay communication. Each of twelve subjects was matched simultaneously with two robots, one of which was programmed to respond cooperatively and the other to respond non-cooperatively toward the moves made by the subject. The subjects believed that they were matched against other human participants in groups of three. Indices of cooperativeness were defined within the context of the economic theory of the game, in such a way that the differential cooperativeness of a subject toward the two robots could be measured dynamically over the path of the game. It was concluded that subjects tended to be more cooperative with cooperative robots than with non-cooperative robots. This paper is a good example of careful experimental gaming that can be mass-produced quite cheaply and easily replicated in a good computerized facility. It was run at the gaming lab of the University of California at Berkeley.

D-39467 'A Laboratory to Facilitate Computer-Controlled Behavioral Experiments.' *Administrative Science Quarterly*, Vol. 14 (June 1969), pp. 202-207. A. C. Hoggatt, J. Esherick, J. T. Wheeler. June 1969.

This is a brief but useful description of a university experimental gaming laboratory. It shows the layout, gives information on computer capability, and makes some observations on costs and uses. 6 pp.

D-39468 *A Learning Tool for Group Problem-Solving: Simulating the Budgeting of Aid for a Small Country* (Berkeley: University of California, Center for Research in Management Science, Working Paper No. 300, 1970). A. C. Hoggatt. April 1970.

Coded; not abstracted; not reviewed.

D-39469 *A Time-Sharing Methodology for Constructing Social Simulations* (Berkeley: University of California, Center for Research in Management Science, Working Paper No. 306, 1970). A. C. Hoggatt, J. Moore. August 1970.

Coded; not abstracted; not reviewed.

D-39470 'Response of Paid Student Subjects to Differential Behavior of Robots in Bifurcated Duopoly Games.' *The Review of Economic Studies*, Vol. 36, No. 4 (October 1969), pp. 417-432. A. C. Hoggatt. October 1969.

Report of an experiment in which a live player plays two robot firms, each in independent markets. The robot firms are programmed to show different levels of cooperation; cooperation is defined by a specific parameter in the construction of the robot decision rules. The 32 subjects were categorized according to the California Psychological Inventory. The experiment was run in the automated laboratory at the University of California, Berkeley. Two hypotheses were tested: (1) differences in cooperativeness between markets for each subject will be strongly related to the settings of the robot parameters, and (2) the absolute level of cooperativeness will be strongly related to the psychological and sociological subsets of variables. Both hypotheses were confirmed. This work is an example of small experiments that should be done in profusion to study structured behavior in economic scenarios. 15 pp.

D-39471 'General Management Simulations: An Approach for the Seventies.' *Simulation and Games* (September 1970), Vol. 1, No. 3, pp. 119-123. R. M. Hodgetts. September 1970.

Coded; not abstracted; not reviewed. See D-39472 for essentially the same arguments.

D-39472 'Management Gaming for Didactic Purposes. A New Look.' *Simulation and Games*, Vol. 1, No. 1 (March 1970), pp. 55-66. R. M. Hodgetts. March 1970.

The basic argument of this paper is that simply constructed but interesting games may be better for teaching purposes than complicated, sophisticated games. To illustrate, it describes Top Management Simulation, a hybrid version of Smith, Estey, and Vines' Integrated Simulation game, and gives a superficial discussion of the game play and structure. While many of the general arguments may have merit, one is not convinced on the strength of this article alone. 11 pp.

D-39473 'Game Theory and Generalization in Ethics.' *Review of Politics*, Vol. 27 (1965), pp. 491-500. R. F. Hopkins. 1965.

The ethical principle of 'generalization,' the practice of appealing to the consequences of a collectivity's doing something as a criterion for its rightness, is examined with respect to certain concepts from game theory. It is suggested that by prescribing prudent strategies, game theory often brings normative structure to state-of-nature situations. Game theory differs from the generalization principle in that individual rather than collective calculations ordinarily form the basis for choice. Game theory may help structure an ethical-normative society, while the generalization principle may help maintain it. An intriguing, but ultimately unconvincing, attempt to meld disparate intellectual traditions. 10 pp.

D-39474 'Conversational Computing Systems as Laboratory Instruments.' *American Psychologist*, Vol. 24, No. 3 (March 1969), pp. 199-202. E. Hunt. March 1969.

Hunt briefly summarizes the laboratory facilities available to psychologists in 1968. Unfortunately, the recent explosive development of computer graphics has dated much of the article. The arguments for a dedicated versus a shared, general computer facility are well presented. Some estimates of lab costs are given. 4 pp.

D-39472 *Homo Ludens: A Study of the Play-Element in Culture* (Boston: Beacon Press, 1950). J. Huizinga. 1950.

Not abstracted; reviewed in R-732-ARPA.

D-39473 'Drug Effects Upon Choice Behavior in Mixed Motive Games.' *Behavioral Science*, Vol. 14 (1969), pp. 443-452. P. M. Hurst, R. Radlow, N. C. Chubb, S. K. Bagley. 1969.

Drugs can influence strategic behavior. D-amphetamine, amobarbital, and a combination of the two were given to some 46 adult male and female paid volunteers, who were then pitted in a series of symmetrical, mixed-motive games. The two-person games included 'Exploiter,' 'Leader,' 'Hero,' and 'Martyr,' and forms of Prisoner's Dilemma. The size of the dosage was such as to produce mood changes but not to debilitate the subjects. Payment was non-trivial and based on performance levels. It was found that the subject's style of play was affected much more than his effectiveness. Drug effects increased total competition and attempted exploitation in the subjects. This is a fine piece of experimentation and provides an interesting reading list of related studies. 10 pp.

D-39474 'Cooperative Versus Solitary Problem Solution.' *The Journal of Social Psychology*, Vol. 11 (1940), pp. 405-409. R. W. Husband. 1940.

A simple experiment was designed to test whether individuals solved problems better than pairs of individuals. Forty subjects were given three types of problems, and their performances were compared with forty pairs of subjects who were instructed to do the same tests cooperatively. The tests included a code solution, a jigsaw puzzle, and five arithmetic problems. For the code and jigsaw tests, cooperation worked significantly better; for arithmetic problems it made no difference. However, cooperative problem-solving took more time than did individual. 5 pp.

D-41801 'Games: Man and Man-Machine.' (Baltimore: Center for the Study of Social Organization of Schools, Johns Hopkins University, 1971). M. Inbar, C. S. Stoll. 1971.

This preprinted excerpt from the authors' forthcoming book, *Developing Social Simulations*, lists and briefly describes several games that are suitable for use in high schools and perhaps colleges (undergraduate level). Addresses are also given for obtaining additional information on the following games: City II, Dispatcher, American Government Simulation, Caribou Hunting, CLUG, Consumer, Crisis, Dangerous Parallel, Democracy, Destiny, Dig, Diplomacy, Disaster, Economic Decision Games, Economic System Game, The Free Enterprise Game, Gettysburg, Generation Gap, Ghetto, Inter-Nation Simulation, Life Career Game, Management, Market, Marketplace, NAPOLI, PLANS, The Railroad Game, The Sierra Leone Game, SIMSOC, SITTE, Starpower, The Sumerian Game, and Trade and Develop. 13 pp.

D-42331 *Differential Games: A Mathematical Theory With Applications to Warfare and Pursuit, Control and Optimization* (New York: John Wiley and Sons, Inc., 1965). R. Isaacs. 1965.

Not abstracted; reviewed in R-732-ARPA.

D-42501 'Learning from Experience in Business Decision Games,' *California Management Review*, Vol. 1 (Winter 1959), pp. 92-107. J. R. Jackson. 1959.

A general survey of business games as of 1959. It describes the UCLA Business Game, Mark II, using the player's manual as the outline. Conceptual and intellectual connections between the UCLA games, the Carnegie Tech game (described as 'promising'), and the American Management Association game are noted. Though the article is substantively outdated, it reveals that much business gaming was underway even before the advent of large-scale computational capabilities, and shows that fairly sophisticated and complicated games can be built and played without computers. 15 pp.

D-42502 *The Executive Game* (Homewood, Illinois: Richard D. Irwin, 1966). R. C. Henshaw, Jr., J. R. Jackson. 1966.

Not abstracted; reviewed in R-732-ARPA.

D-42503 *UCLA Executive Game #2, A Preliminary Report* (Los Angeles: UCLA Graduate School of Business Administration, Discussion Paper #66, April 2, 1958). J. R. Jackson. 1958.

This provides supporting documentation for the UCLA Business Game #2, perhaps the most widely known and used business game in existence (see also D-42504, D-42505). See Richard C. Henshaw, Jr. and James R. Jackson, *The Executive Game*, Homewood, Ill.: Richard D. Irwin, 1966, for an updated, fully detailed version of the game.

D-42504 *UCLA Executive Game #2, Mathematical Model and Computer Code* (Los Angeles: UCLA Graduate School of Business, Discussion Paper #70, April 30, 1958). J. R. Jackson, K. R. Wright. 1958

This provides supporting documentation for the UCLA Business Game #2, perhaps the most widely known and used business game in existence (see also D-42503, D-42505). Periodic updates and repeated usage have sustained this teaching and training device, now known as the Executive Game. (See Richard C. Henshaw, Jr. and James R. Jackson, *The Executive Game*, Homewood, Ill.: Richard D. Irwin, 1966, for the more recent version.)

D-42505 *UCLA Executive Game #2, Computing Instructions* (Los Angeles: UCLA Graduate School of Business, Discussion Paper #69, April 8, 1958). K. R. Wright, J. R. Jackson, J. L. McKenney. 1958.

This provides supporting documentation for the UCLA Business Game #2, perhaps the most widely known and used business game in existence (see also D-42503, D-42504). Periodic updates and repeated usage have sustained this teaching and training device, now known as the Executive Game. (See Richard C. Henshaw, Jr. and James R. Jackson, *The Executive Game*, Homewood, Ill.: Richard D. Irwin, 1966, for the more recent version.)

D-43021 *A Search Game* (Santa Monica: The Rand Corporation, RM-3717-PR, 1964). S. M. Johnson. April 1964.

This paper is one of a series on searches and duels. They are all primarily mathematical and are part of the literature on game theory. However, they are all relevant to the study of tactical combat and provide a useful mathematical tool in work on weapons evaluation. A hide-and-seek game is

formulated and partially solved. The hider chooses an integer from 1 to n; the hunter makes a guess and is told whether he is too high or too low. The process is repeated until he guesses correctly. The payoff is the expected number of guesses. 13 pp.

D-43001 *Game Theory* (Santa Monica: The Rand Corporation, P-1166, 1957). H. Kahn, I. Mann. July 1957.

This was written as a chapter for a book, *Military Planning in an Uncertain World*, that was never published. Though somewhat dated, it presents some useful basic ideas of game theory for the gamer or behavioral scientist. Especially noteworthy is a discussion of the different aspects of a deterrence situation. 65 pp.

D-43002 *Monte Carlo* (Santa Monica: The Rand Corporation, P-1165, 1957). H. Kahn, I. Mann. July 1957.

This paper was written as a chapter for a book, *Military Planning in an Uncertain World*, that was never published. The discussion of various Monte Carlo techniques is somewhat dated and provides little new information; but it is enjoyable to read for its 'Kahnisms' and easy prose style. 28 pp.

D-43003 *Techniques of Systems Analysis* (Santa Monica: The Rand Corporation, RM-1829-PR, 1957). H. Kahn, I. Mann. June 1957.

This was written as a chapter for a book, *Military Planning in an Uncertain World*, that was never published. Concisely and clearly, under the headings of Designing the Offense, Probabilistic Considerations, Designing the Defense, The Two-Sided War, and Evaluation and Criticism, it describes the work of systems analysis, which is defined as being related to operations research the way strategy is to tactics. Though the subject is not strictly gaming, the discussion of model-building applies directly to the construction of rigid war games, and, to some extent, to structuring virtually any diplomatic-military exercise. 161 pp.

D-43004 *Ten Common Pitfalls* (Santa Monica: The Rand Corporation, RM-1937, 1957). H. Kahn, I. Mann. July 1957.

This was written as a chapter for a book, *Military Planning in an Uncertain World*, that was never published. The authors discuss dangers in constructing models that a good systems analyst should be aware of. The contents are indicated by the titles of the sections: Modelism, Statistical Uncertainty, Real Uncertainty, Over-Concentration, Phasing, Over-Ambition, Fanaticism, Formalism, and The Great Bitch. Over-Concentration refers to looking in the wrong place; Phasing deals with the tendency to forget that today's projected system may not be in phase for another five to ten years. Formalism is the state wherein one listens more or less only to oneself, and the Great Bitch is the state wherein there is a simple fatal flaw in the entire system that, upon reflection, would be obvious to the lowest-grade member working in the team. This is a humorously written guide that is still useful. 55 pp.

D-43005 *War Gaming* (Santa Monica: The Rand Corporation, P-1167, 1957). H. Kahn, I. Mann. July 1957.

This is a brief paper on the do's and don't's of gaming in three parts: techniques of systems analysis, techniques of operations research, and philosophical and methodological comments on gaming. The paper is done in characteristic Herman Kahn style. Under the main headings there are sub-headings covering key words and concepts. For example, under the heading Designing the Defense appear two-sided war, evaluation and criticism; under Operations Research appear probability and statistics, Monte Carlo, game theory, elementary economics and programming. The paper concludes with *Ten Common Pitfalls* (published separately; see D-43004) and nine helpful hints. This paper is a useful aide-memoire to someone who wants to design his own game. It is surprisingly up-to-date. 14 pp.

D-43006 *A Computer Program for an Oligopoly Business Game* (New Haven: Yale University, Technical Report No. 6, 1970). R. Katz, G. Wolf. 1970.

This paper discusses the design of a computer program used in teaching and experimental research on economic decisionmaking. The program reflects these two uses: it is designed (1) to be used and easily understood by a student unfamiliar with interactive computing, and (2) to allow the experimenter great flexibility in specifying the experimental situation. In several cases, efficiency or economy of operation was sacrificed to serve these uses, as well as the subordinate need to make the game readily transferable to

other locations. The game was designed by Richard Levitan and Martin Shubik in accordance with current economic theory. (See also D-68002.) 14 pp.

D-45007 'The Empirical Determination of Game-Theoretical Strategies.' *Journal of Experimental Psychology*, Vol. 61 (1961), pp. 462-468. H. Kaufman, G. M. Becker. 1961.

Report of a study of the behavior of naive subjects in a strategy-making situation where a normative solution, i.e., game theory, can be stated. In simplest game-theory terms, subjects were required to find optimal strategies in a two-person zero-sum game under certain conditions. The game-theory solution provides a logical reference or ideal to which the actual game playing is compared. The procedure provides a dynamic behavioral analysis of decision problems usually handled by the game-theory model. 6 pp.

D-46151 'Fighting a Logistics War in the Laboratory.' *U.S. Naval Institute Proceedings* (September 1959), pp. 126-129. L. B. Kelley. September 1959.

A capsule summary of the Air Force project officer's view of Rand's Logistics Simulation Laboratory, circa 1959. It describes general rationales for gaming large-scale systems and gives a balanced view of LSL's possibilities. 4 pp.

D-46152 'Conceptual and Methodological Considerations in the Study of Trust and Suspicion.' *Journal of Conflict Resolution*, Vol. 14, No. 3 (September 1970), pp. 357-366. H. W. Kee, R. E. Knox. 1970.

The authors surveyed experimental studies and theoretical and methodological treatments of trust and suspicion and found them lacking in valid, consistent evidence to elucidate the meaning of these notions. They assert that in order to provide useful evidence, Prisoner's Dilemma and other non-zero-sum games must offer sequential choices, meaningful incentives (not just paper scrip or token cash payment), and continuous psychological monitoring of the players' state of mind. Though this analysis itself does not shed much light on trust and suspicion, it is useful in summarizing major work on the subject and in providing a bibliography. 10 pp.

D-46153 'An Experiment on Conformity to Group Norms Where Conformity is Detrimental to Group Achievement.' *American Sociology Review*, Vol. 19 (1954), pp. 667-677. H. H. Kelley, M. M. Shapiro. 1954.

The purpose of this study was to investigate conformity in a situation where it is detrimental to the success of the group. The hypothesis was that under these circumstances, members who feel themselves to be highly accepted by their colleagues will exhibit less conformity than members who feel less accepted. The comparison of subjects in two experiments intended to induce different feelings of acceptance failed to support the hypothesis. 10 pp.

D-46154 'Negotiating the Division of a Reward Under Incomplete Information.' *Journal of Experimental Social Psychology*, Vol. 3, No. 4 (October 1967), pp. 361-398. H. H. Kelley, L. L. Beckman, C. S. Fischer. 1967.

A mixed-motive bargaining game involving division of a joint reward by two negotiators was used in three experiments. The implications of the model for the mechanisms underlying the bargaining process are discussed. 37 pp.

D-46201 *Optimal Altitude for Antimissile Detonations: A Game Theory Analysis* (Santa Monica: The Rand Corporation, RM-3328-PR, 1962). J. W. Kitchen. November 1962.

This paper treats a situation where an ICBM plunges toward a target defended by one or more AICBM missiles. It is assumed that if the defender identifies the ICBM and scores a hit within the lethal radius of the AICBM before the ICBM detonates, the ICBM does no damage (no sympathetic autodetonation). If the ICBM detonates first, however, it does an amount of damage that depends on the height of the detonation. The defender has a dilemma. If he tries to knock out the ICBM at a great height, he is less likely to identify and kill it than if he waits until it is lower. On the other hand, if he waits until it is low, it may explode before he attacks it, at an altitude low enough to produce severe damage. The attacker must decide at what altitude he will detonate his AICBM every time, since then the attacker would detonate the ICBM always just a little above that altitude. Thus, the strategies involve random selection of altitudes for both the attacker and the defender. In this paper the best strategies for both the attacker and the defender are found, first for just one defense missile, and then for multiple

defense missiles.

D-46202 *Computer Simulation Programming Languages: Perspective and Prognosis* (Santa Monica: The Rand Corporation, P-3599, September 1967). P. J. Kiviat. 1967.

A thoughtful discussion of the various simulation modeling and programming systems in use. It covers the theories of simulation modeling and programming; the design aims of some 'second-generation' simulation programming languages; and comments on the probable future development of simulation languages and programming. 22 pp.

D-47731 *Cybernetics, Simulation, and Conflict Resolution. Third Annual Symposium of the American Society for Cybernetics* (New York: Spartan Books, 1971). Edited by D. E. Knight, H. W. Curtis, L. J. Fogel. 1971. Not abstracted; reviewed in R-732-ARPA.

D-48430 'The Past, Present, and Future of General Simulation Languages.' *Management Science*, Vol. 11, No. 2 (November 1964), pp. 236-267. H. S. Krasnow, R. A. Merikallio. 1964.

An excellent discussion of the problems involved in the design of general simulation languages. It compares SIMSCRIPT, CSL, GPSS, SIMPAC, and DYNAMO with respect to flexibility and utility of output, time series, reports concerning the state of the system, summary statistics, efficiency, and ease of use. 32 pp.

D-48701 'Game Theory and Models of Negotiation.' *Journal of Conflict Resolution*, Vol. 6, No. 1 (March 1962), pp. 1-4. H. W. Kuhn. 1962.

As editor of a special issue of the *Journal of Conflict Resolution* Harold Kuhn provides an excellent, balanced overview of the application of game theory to negotiation. Two familiar complaints about applied game theory are that (1) the theory abstracts out essential aspects of an empirical context and (2) assumptions made in the interest of theoretical tractability produce results that are insufficiently detailed. Responsibility for this state of affairs, according to Kuhn, must be shared jointly by the game theorist and the behavioral scientist. Lack of success in the application of the theory of games is not the fault of the mathematicians whose proper concern is the abstract structure of the theory, but rather of the behavioral and social scientists who have not provided inputs in the form of more restrictive assumptions about the behavior of the players and the setting of the games. However, this does not absolve mathematicians entirely from their responsibility because too often they have put forth game theoretical models in the guise of reality when these models were not supported by even plausible empirical assumptions' (p. 2). Little wonder, then, that 'solutions' to games describing negotiations have not been forthcoming, given the paucity of theory and experimental evidence on the subject. To be effective, a game-theory model of negotiations must include (1) an extensive form, i.e., a literal translation of the rules of a given situation into a formal descriptive system, to describe the temporal sequence of negotiations, (2) a theory of preferences to account dynamically for participants' objectives as they are modified through the negotiation process, and (3) solution concepts that are not static, to account for the dynamic aspects of preference formation and modification. This article is a succinct summary for the layman of several key conceptual and technical challenges confronting game and behavioral scientists. 4 pp.

D-48801 'A Vietnam Peace Game: Computer-Assisted Simulation of Complex Situations in International Relations.' *Computers and Automation*, Vol. 16 (March 1967), pp. 14-18. J. Larivière. 1967.

The results are sketched of a project carried out at the Canadian Peace Research Institute, Charlottetown, Ontario, under a UNESCO and Canadian National Commission grant. The article is written in lyric style and conveys almost no information about the game. What are its purpose and underlying theoretical structure? What data were used to support it? What did it cost? Have attempts been made to validate it? Who uses it? By inference and intuition, it appears to be a man-machine game employing multiple moves, taking about 30 hours to play, and involving 30 to 40 players. A clue about the elements treated in the game is given in this comment: '(Information from decision forms) is fed into a computer to determine the consequences of the decisions. These consequences are then fed back into the game by giving each team new figures at the start of the next period for its budget and military allocations, military losses and gains, return on previous investments, decision latitude, and the government's prospects for keeping power' (p. 15). Left unsaid is anything about the relationships that determine all

those consequences. 5 pp.

D-51741 *FAST-VAL: A Model for Forward Air Strike Evaluation* (Santa Monica: The Rand Corporation, P-3076, 1965). J. R. Lind. March 1965. One of a series on FAST-VAL, the Forward Air Strike Evaluation Model, which 'permits the extension of gaming from situations in which weapon effects are well known to players to those in which weapon effects must be developed.' Background for FAST-VAL's development, some assessments of its usefulness, and its potential war-gaming applications are presented. The paper is most useful if read as part of the series. 6 pp.

D-51742 *STAPOL. A Simulation of the Impact of Policy, Values, and Technological and Societal Developments upon the Quality of Life* (Middletown, Connecticut: Institute for the Future, WP-12, October 1970). D. L. Little, R. Feller. October 1970.

STAPOL, 'State Policy,' is the attempt of the Institute for the Future to bring together several of its separate interests in gaming, value change, forecasting, and social indicators. This paper is a superficial description of the game, whose stated purpose is to analyze 'the impact of government policy, social values, and technological and social developments upon the quality of life in a hypothetical, highly industrialized, two-party, New England State.' The game may either be run manually or totally on a computer. Players serve as state planner, societal evaluator, and 'exogenous-event assessor.' The major output indicator of the game play appears to be the 'quality of life,' measured by 'indices of satisfaction.' Not having seen the game played and not having a more complete version of the manual, the reviewer is hard put to judge what exactly the game does accomplish. The participant's appraisal does not help, either. 10 pp.

D-51743 *The American Chessspiel: A Game For Practicing the Art of War Upon a Topographical Map* (Boston: W. B. Clarke Co., 2nd edition, 1898). W. R. Livermore. 1898.

Not abstracted; reviewed in R-732-ARPA.

D-51744 *Models and Simulation: Some Definitions* (Middletown, Conn.: Institute for the Future, WP-6, April 1970). D. L. Little. 1970.

The purpose of this paper is apparently to educate people engaged in urban and regional planning. After making the *de rigueur* differentiation of gaming, simulation, and modeling, it summarizes the current lore on the use of computers in planning. Two appendices are noteworthy. One discusses Richard Meier's often-cited article, 'Exploration in the Realm of Organization Theory IV: The Simulation of Social Organization,' *Behavioral Science*, Vol. 6 (July 1961), pp. 232-248, so fully as to obviate reading it. The other attempts with limited success to describe how disciplines other than planning are using simulation and gaming. Though slight, the paper is an adequate introduction for the novice or the undergraduate student. 17 pp.

D-51745 'I-Trust: A Notion of Trust in Three-Person Games and International Affairs,' *Journal of Conflict Resolution*, Vol. 8, No. 3 (September 1964), pp. 271-280. B. Lieberman. 1964.

Coded; not abstracted; not reviewed.

D-53221 *Games and Decisions: Introduction and Critical Survey* (New York: John Wiley, 1957). R. D. Luce, H. Raiffa. 1957.

Not abstracted; reviewed in R-732-ARPA.

D-54001 *Values of Large Games. IV: Evaluating the Electoral College Exactly* (Santa Monica: The Rand Corporation, RM-3158-PR, 1962). I. Mann, L. S. Shapley. May 1962.

Using game theory, the authors examine the distribution of power in the Electoral College by means of a straightforward computational procedure. It is concluded that the larger states have a bias in their favor by as much as five percent, considering only the numerical properties of the College and maintaining the *ceteris paribus* constraint for all other considerations. This is an interesting approximation and creative characterization of a political institution. The techniques for precise explication ought to prove useful to those interested in voting games and experimentation. 15 pp.

D-54002 *An Objective Appraisal of War Gaming* (Washington, D.C.: HQ USAF, Operations Analysis, 1970). G. R. McNichols. 1970.

Notes on the uses of war gaming prepared for a short course on military operations research. Included are an example of the design of a war gaming

study and a discussion of the advantages and disadvantages of gaming. Trends in gaming are noted, and it is observed that gaming as a discipline virtually lacks a common theory and methodology. A good though not technically deep article. 41 pp.

D-54003 *Fundamentals of War Gaming* (Newport, R.I.: U.S. Naval War College, 1966, 3rd ed.). F. J. McHugh. March 1966.

Not abstracted; reviewed in R-732-ARPA.

D-54004 'Modern War Gaming: State of the Art,' *Marine Corps Gazette* (November 1960), pp. MCA-10-MCA-12. E. S. Maloney. November 1960.

This is a concise overview of war gaming. Designed to introduce Marines to the subject, it was prompted in part by results of a survey conducted by the Marines' Landing Force War Games Panel in 1959. That survey indicated that the level of understanding and general knowledge of war gaming in the Corps was not high. The article is discursive and errs on several points, e.g., war gaming is not necessarily a 'low cost means of evaluating the validity of assumptions and determining the sensitive factors in a military plan,' and the optimum level of player size per team in game context is not limited to a superior and two subordinate teams. 3 pp.

D-54005 'Gaming as a Military Research Procedure,' in Ithiel de Sola Pool, ed., *Social Science Research and National Security* (Washington, D.C.: Smithsonian Institution, 1963), pp. 188-220. V. V. McRae. 1963.

McRae draws on his considerable experience as a gamer both in and outside government in this broad survey of the evolution and uses of gaming as an acceptable methodology. Preceded by the standard explanation of terminology and syntax, the meat of the article is a description of how to design a game. Historical examples are well used to illustrate. While the sophisticated reader might fault the author on methodological details, the overall treatment is sound. 32 pp.

D-54006 *Simulation Gaming for Management Development* (Boston: Harvard University, Graduate School of Business Administration, 1967). J. L. McKenney. 1967.

Not abstracted; reviewed in R-732-ARPA.

D-54007 *Bibliography on Military Applications of Operations Research* (Ottawa, Canada: Computation and Analysis Section, Defense Research Board, March 1969). H. J. Malik. March 1969.

This is a competent yet unsatisfying bibliography. The publications listed are generally of good quality (though some are of poor quality or are irrelevant), but they are not classified by subject. Since care and effort are evident in this compilation, it is a pity that the author did not make a small additional effort to classify the entries into a five- or six-way index. In its current form, an unannotated listing, it is not very useful. 93 pp.

D-54008 *The Simulation Laboratory as a Developmental Tool* (Santa Monica: The Rand Corporation, P-1454, August 1958). W. H. McGlathlin. August 1958.

This paper describes how simulations serve to distill and reproduce a real-world situation. Simulations are classified by objective: Auristic games are used to explain; Monte Carlo games are used to estimate the solutions of problems that can be specified mathematically but whose analytic solutions are very difficult or impossible; developmental/simulation gives insight into complex problems that can only be poorly specified at first. Another type of simulation provides a prototype or feasibility demonstration of some proposed innovation. LP-II, a developmental simulation intended to suggest feasible support plans for a ballistic missile, is discussed. Training simulations are the last type mentioned. 15 pp.

D-54009 'Some Recent Substantive and Methodological Developments in the Theory of Organizational Decision-Making,' in Austin Ranney (ed.), *Essays on the Behavioral Study of Politics* (Urbana: University of Illinois Press, 1962), pp. 191-208. J. G. March. 1962.

This article gives a good overview of the state-of-the-art of organizational theory in 1962. Sections individually discuss the concepts of organizational goals, expectations, and learning, and suggest the implications of work in each. The author argues that neither classical theory, mathematics, nor verbal analysis has proved effective in dealing with the particular requirements of the study of organizational theory. He recommends, instead, approaching it through computer simulation and model-building (including the

construction of training games), and mentions the Carnegie Tech Management Game and work in Rand's System Research Laboratory in this regard. 18 pp.

D-54010 'An Evaluation of a Decision Simulation as a Learning Environment.' *Management Technology*, Vol. 3 (May 1963). J. L. McKenney. 1963.

This is virtually a reprise of the author's 'An Evaluation of a Business Game in an MBA Curriculum' (D-54012), which was more detailed and more informative.

D-54011 *The Simulated Aircraft and Its Failure Model in LP-1* (Santa Monica: The Rand Corporation, RM-2177, May 1958). W. H. McGlothlin, G. C. Noonan, Jr. May 1958.

As part of its first major experiment, Laboratory Problem 1 (LP-1), the Logistics Systems Laboratory of The Rand Corporation simulated the supply and maintenance activities of a logistics system supporting an Air Defense Command aircraft. These simulations required development of a model of an aircraft and its parts, and a model of the parts failures occurring as a result of flying and maintenance activity. This paper describes the models that were developed. 60 pp.

D-54012 'An Evaluation of a Business Game in an MBA Curriculum.' *Journal of Business*, Vol. 35 (July 1962), pp. 278-286. J. L. McKenney. 1962.

An experiment testing the learning of three concepts was used to compare the performances of MBA students taught by a game and those taught by standard methods. The concepts were (a) 'Today's decisions create tomorrow's environment,' (b) 'Goals and plans are carried out by a series of consistent decisions to vary in accordance with the environment,' and (c) 'Functional decisions of a firm are interrelated' (e.g., marketing decisions affect production decisions and vice versa). The tests, statistical procedure, and methods of grading are clearly described. Discussion and the conclusions indicate some evidence favoring the use of gaming over conventional methods. For example, gaming seemed better at showing concept (c). This endeavor seems a model of carefulness and rigor. 9 pp.

D-54013 *The Management Game: Simulated Decision Making* (New York: The Macmillan Company, 1970). F. W. McFarlan, J. L. McKenney, J. A. Seiler. 1970.

A thorough documentation and description of the Harvard Business School Management simulation, which was designed to provide experience in business decisionmaking under conditions of uncertainty. It is a straightforward and careful explanation, complete with virtually every decision form and piece of paper needed to play this large game. 153 pp.

D-54014 'A Survey of Marketing Games.' *Journal of Marketing*, Vol. 26 (July 1962), pp. 69-72. J. F. McRaith, C. R. Goeldner. July 1962.

Most people in marketing have had no contact with marketing games, and many are not even aware that they exist. This article provides an illustrative list of the games available to marketing executives and educators. 4 pp.

D-54015 'Principles for Assessment of Simulation Model Validity,' in A. I. Siegel, ed., *Symposium on Computer Simulation as Related to Manpower and Personnel Planning* (Washington, D.C.: Naval Personnel Research and Development Laboratory, July 1971), pp. 157-165. J. P. Mayberry. 1971.

A handy list of checks on the validity of simulation models that stresses the nature of the model rather than statistical manipulation. 8 pp.

D-57711 'Pacifist Bargaining Tactics: Some "Outsider" Influences.' *Journal of Conflict Resolution*, Vol. 13 (1969), pp. 487-93. R. J. Meeker, G. H. Shure. 1969.

The authors report the results of a controlled experiment to test the effects of third-party intervention in a pacifist-adversary situation. Pacifist behavior, it is argued, is rarely observable without considerable contamination from the setting in which it occurs or without explicit extra-game interpretation of a pacifist's moral basis of behavior. Described is a simple, two-person, mixed-motive, non-zero-sum game employing varying types and amounts of inter-subject information and communication. The voluntary application of a mild electric shock to the 'pacifist' provides the dynamics of the game. The experiment's outcomes are discussed. 7 pp.

D-57712 'Gaming Simulation for Urban Planning.' *Journal of the American Institute of Planners*, Vol. 32, No. 1 (January 1966), pp. 3-17. R. L. Meier, R. D. Duke. January 1966.

This article has been influential in urban planning and urban simulation/gaming. It advocates gaming as a means of managing the complexity of real-world situations. But gaming is not a panacea: the authors recount several instances of the failure of urban gaming. In suggesting a workable gaming approach to urban development, the authors describe their own game, METROPOLIS. 14 pp.

D-57713 'Computer-Controlled Experiments in Psychology.' *Behavioral Science*, Vol. 9 (1964), pp. 378-382. D. M. Messick, A. Rapoport. 1964.

The authors describe their gaming facility, the Psychometric Laboratory at the University of North Carolina, by way of advocating more and more detailed computer-based experimentation in the behavioral sciences. Such experimentation is said to offer standardization of experimental variables, flexibility of means to handle generated data, economy of operation compared with conventional experimental methods, and control over unwanted complexity. The work of this laboratory is likened to computer-assisted instruction (CAI). Theoretical research avenues are suggested, but the reader is left in the dark as to how to proceed. The treatment is marred by its failure to deal with counter-arguments. 4 pp.

D-57714 *Self-Administered Instructions for the Territories Game* (Santa Monica: System Development Corporation, TM-7422, June 1965). R. J. Meeker, G. H. Shure. June 1965.

This is an example of careful writing of instructions that is worth emulating in the preparation of instructional material for a simple experimental game. Even so, there are omissions. For example, the players are not told how much time they may take or how many times they are to play the game. Undoubtedly such information was given orally. But it should be included in the documentation to enable other instructors to replicate the experiment. 69 pp.

D-58801 *JUDGE: A Value-Judgment-Based Tactical Command System* (Santa Monica: The Rand Corporation, RM-5147-PR, March 1967). L. W. Miller, R. J. Kaplan, W. Edwards. March 1967.

Description of the Judged Utility Decision Generator (JUDGE), an advanced man-machine technique for use in allocating missions in response to requests for close air support. JUDGE is predicated on two notions: (1) value judgments (estimates of military worth associated with requests) can be made explicitly in real time by appropriately trained personnel, and (2) the system ought to maximize the aggregate expected utility of the dispatching decisions that it makes. Input to the system is a forecast, in probabilistic terms, of demand for close air support; constraints, derived from the number of aircraft to be used; and the distribution of turnaround times--over one day. The day is divided into shorter periods, and sorties are allocated as available for use in each period. As each request is received, JUDGE makes a dispatching decision based on the judged utility of the request, kill probability data, the number of sorties remaining in the period, and the times. The technique used in obtaining value judgments is described and the results of a field study using JUDGE are discussed. The study demonstrated the superiority of the JUDGE technique over the simulated current method as measured by an expected utility criterion and various indicators of consistency. It was also shown that the performance of JUDGE is not severely degraded by errors in forecasting. 63 pp.

D-58811 *War Gaming as a Technique of Analysis* (Santa Monica: The Rand Corporation, P-899, 1954). A. M. Mond. September 1954.

The author divides military problems into 'factorable'--those that can be solved out of context or environment, and 'unfactorable'--those that cannot be dealt with outside their natural context. Gaming techniques are being used to solve the latter type. Games used as analytic aids should be readily playable as many times as necessary for the players to understand the game's structure, and should have a fixed set of rules so that experience gained in one play is valid in other plays. Since rules are time-consuming to write, general-purpose games are more common than special-purpose games. Three levels of resolution are identified: the divisional commander, the theater commander, and the commander-in-chief. Gaming, the author suggests, is useful in solving unfactorable problems because it offers a way of pooling expert knowledge to break such problems down into manageable parts. This is an older but quite durable article. 12 pp.

D-58912 *How to Play War Games in Miniature* (New York: Walker, 1962). J. Morschauser. 1962.

This is a well-written manual for the enthusiast on how to set up war games for 'the shock period,' 'the musket period,' and the 'modern period' of warfare (classification based on weapon effects). Rules are given, and there are tables for calculating the force of any military unit. For the professional war gamer, it suggests that understanding the planning factors in entertainment war games may shed light on the planning factors in serious war games. The book is short, interesting to read, and appends lists of magazines and books for the enthusiast and the locations for obtaining equipment. 132 pp.

D-58913 'Simulations, 'Realities,' and International Relations Theory,' *Simulations & Games*, Vol. 1, No. 2 (June 1970), pp. 111-134. G. Modelska. 1970.

A sensible article on model-building in international relations as affected by work on the Inter-Nation Simulation (INS). It faults INS for (1) making the nation-state an independent, economically self-sufficient unit completely under governmental control, and (2) allowing no institutions other than the government to play a role. Alternative model-building schemes are discussed. Though this paper is well documented and makes many useful observations on the state of the art, it fails to come to grips with the basic questions of what kinds of models should be built for what purposes, and what are the criteria by which a model's effectiveness can be judged. Broad, large-scale simulations and games not directed at answering fairly specific questions are generally of little use. 23 pp.

D-58914 *The Carolina Population Center Family Planning Policy Game* (Chapel Hill: Carolina Population Center, University of North Carolina, No. 10, March 1, 1971). R. S. Mo eland, K. Chu, E. Jacobson, T. H. Naylor. 1971.

This paper's implied purpose, to aid policymakers, is not fulfilled. First, it seems to assume that socioeconomic and demographic goals can be foreseen with precision. (In fact, the model that is presented optimizes a crude, ill-defined, collective objective function.) Second, it fails to show how to estimate the real political and economic costs of any policy package that the model might study. However, for teaching or educational purposes, the game and model are more than adequate. The reader's interest is sustained in learning how the game has been used, how it is played, and what are some outcomes. Generally, the game is easy to understand, inexpensive to run, readily adaptable to changes in structure, well documented, and apparently built up from simple routines. Its reference system, though hypothetical, is plausible. The authors' claim that the game can be made context-specific with only 'several weeks of econometric work and sufficient reprogramming of the model' is questionable. Contexts vary greatly yet are difficult to specify precisely. The references to Taiwan and Korea, unsupported by any evidence, are inadequate justification. The confusion of purpose between education and policy assistance weakens what would otherwise be an excellent addition to the teaching literature on gaming. The concise presentation is noteworthy. 30 pp.

D-60051 *A History of Board Games Other Than Chess* (Oxford: Clarendon Press, 1952). H. J. R. Murray. 1952.

Not abstracted; reviewed in R-732-ARPA.

D-61501 *Selected Urban Simulations & Games* (Middletown, Connecticut: Institute for the Future, WP-4, April 1970). M. Nagelberg, D. L. Little. 1970.

A succinct summary of urban-oriented gaming and simulation activity from 1958 to 1970. Each of the games is briefly characterized according to purpose, use, developer, assumptions, spinoffs, environment approximated, type of model employed, computer requirements, size and character of the program used, data input requirements, documentation sources (from which the summaries apparently were compiled), and other miscellaneous distinguishing features. Though the need for such inventories is great, the professional learns very little about these games that he does not already know, often in far greater detail. No effort has been made to do more than record information in an uncritical fashion. On balance, however, the effort is a useful addition to the teaching literature and helps sort out much diverse activity. 24 pp.

D-61502 'Declarer: A Learning Bridge-Playing Program Which Generalizes and Infers,' *Behavioral Science*, Vol. 16 (1971), pp. 404-410. C. N. Napjus. 1971.

Programs that combine expertise in both artificial intelligence and game-playing are quite rare. The author has capitalized on the structured environment of a card game to develop a very sophisticated SNOBOL3 representation of the rules, procedures, and order of play of bridge. It incorporates a learning process similar to the way humans learn to play the game: building upon experience, recognizing significant card patterns, and altering intended play in response to the opponent's actual play. This endeavor is in the same genre as A. L. Samuel's famous checker-playing computer programs of the late 1950s and the automated chess programs that have had great and continuing popularity. 7 pp.

D-61503 'Verification of Computer Simulation Models,' *Management Science*, Vol. 14, No. 2 (October 1967), pp. B92-B101. T. H. Naylor, J. M. Finger. 1967.

The authors identify three theoretical positions on verification: (1) rationalism, which holds that the model theory is simply a system of logical deductions from a series of synthetic premises of unquestionable truth, (2) empiricism, which regards observation through the senses as the primary source and ultimate judge of knowledge, and permits postulates that cannot be independently verified, and (3) Friedman's 'positive economics,' which holds that the validity of a model depends not on the validity of the assumption on which the model rests but on the ability of the model to predict the behavior of the dependent variables. Computer simulation warrants a multi-stage verification procedure incorporating all three approaches. The first stage is the selection of basic segments of the model; the second stage is an attempt to verify postulates by existing statistical tests; and the third stage consists of testing the model's ability to predict the behavior of the system under study. The authors distinguish between using simulation for descriptive and for prescriptive purposes. Graphical goodness-of-fit, an adequate measure for descriptive purposes, is inadequate for more sophisticated analyses. For the latter, the following statistical methods are available: (1) analysis of variance, (2) chi-square test, (3) factor analysis, (4) Kolmogorov-Smirnov test (a distribution-free, nonparametric test concerned with the degree of agreement between the distribution of a set of sample values and some specified theoretical distribution), (5) nonparametric tests, (6) regression analysis, and (7) spectral analysis. 10 pp.

D-61504 *Computer Simulation Techniques* (New York: John Wiley & Sons, 1966). T. H. Naylor, J. L. Balintfy, D. S. Burdick, K. Chu. 1966.

A fairly comprehensive overview of an extremely complicated and fragmented field. The book starts well with an introductory chapter, 'Introduction to Computer Simulation,' and 'Planning Computer Simulation Experiments.' But the reader is next confronted with two indigestible chapters on random numbers and stochastic variates. It would have been better to delete them or make them appendixes. The remaining sections on queues, large economic systems, languages, verification, and experimental design are all worthy additions to the literature. The short chapter on verification is a gem of concise writing that deserves careful reading. The book is a solid text and sourcebook, contains several excellent bibliographies, and could even be used as a text for an advanced undergraduate or graduate course in simulation. 352 pp.

D-61505 'On Time Flow Mechanisms for Discrete System Simulation,' *Management Science*, Vol. 18, No. 1 (September 1971), pp. 59-73. R. E. Nance. 1971.

Previous concepts of time-flow mechanisms are inadequate for categorizing or describing the algorithms for time flow that may prove most efficient for a particular systems application. The work of Kiviat provides a more meaningful categorization. The patrolling repairman problem serves as an example of the ambiguity and inconsistency in the use of fixed-time and next-event classification. Three algorithms for time flow in the patrolling model are offered. Theoretical development is provided for the two more sophisticated algorithms—the variable increment (VIA) and the minimum increment comparison (MIC). Comparison of execution times for the three algorithms shows the constant increment (CI) to be generally more efficient. The concept of a continuum of algorithms for representing the passage of time is advanced. Fixed-time methods with change in time considered a 'clock tick' define one end of the continuum, and next-event methods utilizing strictly the push down/pop up stack approach define the other. Between

these two extremes lie other algorithms possessing characteristics of both but which may prove more advantageous for any specific application of discrete system simulation. 15 pp.

D-63151 *Use of Multiple On-Line, Time-Shared Computer Consoles in Simulation and Gaming* (Santa Monica: The Rand Corporation, P-3606, 1967). G. M. Northrop. June 1967.

Some on-line, time-shared, multiple-console computer systems now allow the use of a common file system. One console can file a message that can be recalled by another console. By programming consoles to interrogate certain files periodically, a crude but highly serviceable store-and-forward communication system can be created. This paper describes the use of the Rand time-shared system, JOSS, in simulation and gaming, and discusses some of the advantages, limitations, and lessons learned. Three different applications are described in some detail. In the first, JOSS is message handler for a BLUE-RED game under the control of GREEN (the referee). A two-party battle between missile-firing submarines constitutes the second application. The third application is a simulation of some facets of the close air-support role of a hypothetical automated tactical air control system. 59 pp.

D-63152 *The Polis Network, an Intercampus Consortium for Instructional Innovation in International Relations* (Santa Barbara: Political Institutions Simulation Laboratory, University of California, March 1971). R. C. Noel. 1971.

This article describes the Polis network through which remote teletype terminals may be linked to each other for political-science simulation and gaming exercises. The network is designed for user convenience, and is reported to have a low overhead operation. A simulation and gaming program library is also being developed. In 1968-69, a foreign policy exercise was held among several campuses. It was repeated in 1969-70 using students from UCSB, UC-Riverside, and Chico State College. In 1971, using a PDP 11, UCSB (the control team), Stanford University, Chico State, UCLA, and UC-Berkeley were successfully interlinked. 23 pp.

D-63153 'The Polis Laboratory.' *The American Behavioral Scientist*, Vol. 12, No. 6 (July-August 1969), pp. 30-35. R. C. Noel. 1969.

The Polis Laboratory is designed for social simulation and the use of gaming methodologies in instruction and research. The name is an acronym for Political Institutions Simulation. The control center has terminal boards with 48 positions throughout the laboratory. The laboratory permits observation of face-to-face interaction by a closed-circuit television system handling up to 10 simultaneously operated video cameras. The cameras may be connected with any of the 48 terminal boards. An internal telephone system is equipped with portable instruments. Future plans call for switching to interactive teletypes. 6 pp.

D-64711 'Factors Affecting Cooperation in a Prisoner's Dilemma Game,' *Journal of Conflict Resolution*, Vol. 9, No. 3 (September 1965), pp. 359-374. S. Oskamp, D. Perlman. 1965.

The authors claim that this series of experiments demonstrates that under some conditions it is possible to obtain high mean levels of cooperation (as high as 70 percent or even 80 percent) in a true Prisoner's Dilemma game. The level of cooperation appears quite sensitive to rather subtle situational factors, such as the source and method of recruitment of experimental subjects and the amount of social interaction between the subjects at the beginning of the experiment. 16 pp.

D-65001 *War Gaming* (Santa Monica: The Rand Corporation, RM-3489-PR, 1963). E. W. Paxson. February 1963.

The paper is an excellent, well-written, and informed survey of war gaming, with reference to the significant literature. Originally prepared as a chapter in Bernard O. Koopman, ed., *Military Operations Research*, the selection has more general appeal. The game classes discussed include Monte Carlo, man-machine, rigid-manual, semi-rigid, and free-form games. Each class is characterized and exemplified; weaknesses and potentially productive research avenues are noted where appropriate. Significant issues for debate among gamers are outlined. 35 pp.

D-65002 'Models of Cooperation and Conflict: A Critical Review,' *Journal of Conflict Resolution*, Vol. 14, No. 3 (September 1970), pp. 389-407. M. Patchen. 1970.

This is a good and quite comprehensive review and synthesis of the literature on bargaining and bidding. The sections include 'Models of Negotiation,' 'Models Predicting Influence Behaviors: Cognitive Models,' 'Learning Models,' 'Reaction Process Models,' and models that share qualities of the foregoing types. A long and representative bibliography is appended. 19 pp.

D-66311 'A Generalized Lagrange-Multiplier Method for Constrained Matrix Games,' *Operations Research*, Vol. 19 (July-August 1971), pp. 933-945. A. I. Penn. July-August 1971.

Describes a general method for solving constrained matrix games of a type occurring frequently in military and industrial operations research. The usual context is the optimal allocation of constrained resources by two opposing sides among a series of independent cells such that the payoff overall is the sum of the payoffs at each cell. The cells themselves might represent separate invasion or supply routes, battlefields, individual targets, or marketing ventures. Generalized Lagrange multipliers (EVERETT multipliers) are used to effect the solution. It is shown that the basic properties of the games preclude the possibilities of nonconcavities or extraneous solutions. 12 pp.

D-67431 *Play, Dreams, and Imitation in Childhood* (London: Koutledge & Kegan Paul, 1962; originally published in 1951). J. Piaget. 1962.

Not abstracted; reviewed in R-732-ARPA.

D-68001 'An Experimental Study of the Allocation of Financial Resources Within Small Hierarchical Task Groups,' *Administrative Science Quarterly*, Vol. 14 (1969). L. R. Pondy, J. G. Birnberg. 1969.

The authors use the phrase 'allocation plan' to mean any feasible budget package of projects or expenditures considered by a committee. Each committee member is assumed to assess alternative allocation plans against his own department's interests. The experiment described in this article was designed to investigate how people vote, given certain voting rules, on fairly simple and clear-cut issues. The test was on the effects of unanimity, majority, and modified majority rule (under the last rule one specific person is given a blocking vote). Three subjects were used in each of 12 replications. The subjects were all members of the MBA class of the University of Pittsburgh. The 36 subjects constituted approximately 30 percent of the class. The subjects were instructed to vote for one of three plans on a series of ballots under the various voting rules. Each was instructed to maximize his own payoff. There was inequality of distribution for each ballot; however, over the set of 18 trials each subject had the opportunity to receive the same number of 2, 5, and 0 payoffs. There were two replications under each of six possible orders, in which the voting rules were tested to control for the effects of practice on performance. There appeared to be a significant effect. This is a worthwhile application of an experimental method to an extremely important decision problem. Though this does not represent enough experimentation to indicate the significance of differences in voting procedures, it is a start. The article also contains a useful bibliography.

D-68002 *User's Guide for Oligopoly Game Data System*, New Haven: Yale University, Department of Administrative Sciences, Technical Report 7, 1971. M. Pomer, G. Wolf. 1971.

A preliminary report on the data system built to run with the experimental and teaching game constructed by Shupik and Levitan. The authors describe how to use the program, which was designed to allow the user to store and manipulate data from a game immediately after the game has been played. (See also D-45006.)

D-68621 'Simulation: Budgeting for a "What If . . ." ' *The Journal of Accountancy* (November 1970), pp. 59-63. L. J. Pryor. November 1970. Coded; not abstracted; not reviewed.

D-68622 'An Interactive Technique for the Analysis of Multivariate Data,' *Behavioral Science*, Vol. 14 (1969), pp. 364-370. L. I. Press, M. S. Rogers, G. H. Shure. 1969.

A description of IDEA, computer software that uses inductive algorithms to parse a data set into decision trees. The procedures are similar to Sonquist and Morgan's better-known AID (Automatic Interaction Detector) package but differ in that IDEA is time-shared, allows other-than-binary branchings, and makes no rigid assumptions about the level of measurement. AID has received the publicity, but Press and company seem to have a better IDEA. 7 pp. (See also D-77916.)

D-6871 'Bargaining Behavior and Orientations in Coalition Formation.' *Sociometry*, Vol. 28 (1965), pp. 124-144. G. Psathas, S. Stryker. 1965.

Theorizing about coalition formation requires attention to processes through which coalitions are formed, attention absent from research reported to date. The coalition process is conceptualized as involving choices regarding offers and counter-offers predicated on definitions of the situation, these definitions shaped by perceptions held by participants in the process arising out of structural conditions underlying the process and by offers and counter-offers themselves. Three studies contributing to a delineation of coalition formation processes are reported. Results suggest that in relationships in which power is differentially distributed, the bargaining behavior of those who are strong is more oriented to and by power than is the behavior of those who are weak. In this light, the coalition process may be understood as one in which rival definitions vie for precedence. 21 pp.

D-69041 *Analysis for Military Decisions* (Santa Monica: The Rand Corporation, R-387-PR, November 1964). E. S. Quade. November 1964.

Not abstracted; reviewed in R-732-ARPA.

D-69042 *Systems Analysis and Policy Planning: Applications in Defense* (New York: American Elsevier, 1968). E. S. Quade, W. I. Boucher. 1968.

Not abstracted; reviewed in R-732-ARPA. Originally published under the same title by The Rand Corporation, R-439-PR, 1968.

D-69043 'On the Use of Game Models in Theories of International Relations.' *World Politics*, Vol. 14 (October 1961), pp. 69-76. R. E. Quandt. 1961.

Summarizing some of Schelling's efforts to link game theory and international relations, particularly bargaining and negotiation behavior, this article adds little to either game theory or international relations. The author concludes with the somewhat vacuous observation that gaming models might be used 'to test particular hypotheses about models and to enlarge the catalogues of possible outcomes and strategies' (p. 76). He fails, moreover, to take into account a large body of literature and practice on gaming as distinguished from game theory; in fact, he uses both terms to mean something like crude game theory. 8 pp.

D-69501 *A Taxonomy of 2 x 2 Games* (Ann Arbor: The University of Michigan, Mental Health Research Institute, 1968). A. Rapoport, M. Guyer. 1968.

The authors observe that a 2 x 2 game has exactly four outcomes, representing the final pairs of strategy choices by the two players. They restrict themselves to an ordinal scale to express the value of the outcome to each player. Furthermore, they limit the ordering to a strict one. In other words, there are four outcomes: *a*, *b*, *c*, *d* for each, where *a* is preferred to *b* is preferred to *c* is preferred to *d*. The remainder of the article is devoted to calculating how many different 2 x 2 games one can construct. The authors show that there are 78 such games, which they classify with respect to the different equilibrium points they may have. For example, there are six no-conflict games where each player has a dominating strategy, five where one player has a dominating strategy, and six where neither player has a dominating strategy. The Prisoner's Dilemma is in a class of its own, with what the authors call a 'strongly stable deficient equilibrium.' This is an extremely useful and straightforward piece of work which should be read by anyone who wishes to use 2 x 2 matrix games for experimental purposes. 12 pp.

D-69502 'Experimental Games: A Review.' *Behavioral Science*, Vol. 7 (1962), pp. 1-37. A. Rapoport, C. Orwant. 1962.

An often-cited but now outdated survey. A more current introduction to game theory and experimental games is M. Dresher, L. S. Shapley, and A. W. Tucker, eds., *Advances in Game Theory* (Princeton: Princeton University Press, 1964). 37 pp.

D-69503 *Simulated Wars in LP-1* (Santa Monica: The Rand Corporation, RM-2117-PR, February 1958). R. M. Rauner. February 1958.

Report of the preliminary results of two simulated wars conducted during the course of work on Logistics Problem 1 (LP-1) at Rand's Logistics Systems Laboratory. The purpose of LP-1 was to compare two logistics systems for the Air Force, one currently in use and the other an experimental advanced system. The wars were made to occur after one and two years of

simulated operation of each of the logistics systems being tested. 31 pp.

D-69504 'Formal Games as Probing Tools for Investigating Behavior Motivated by Trust and Suspicion.' *Journal of Conflict Resolution*, Vol. 7, No. 3 (September 1963), pp. 570-579. A. Rapoport. 1963.

Coded; not abstracted; not reviewed.

D-69505 'The 'End' and 'Start' Effects in Iterated Prisoner's Dilemma.' *Journal of Conflict Resolution*, Vol. 10, No. 3 (September 1966), pp. 363-366. A. Rapoport, P. S. Dale. 1966.

Coded; not abstracted; not reviewed.

D-69506 *Prisoner's Dilemma, A Study of Conflict and Cooperation* (Ann Arbor: University of Michigan Press, 1965, 258 pp.). A. Rapoport, A. M. Chammah. 1965.

Not abstracted; reviewed in R-732-ARPA.

D-69507 'A History of War Games.' *Reserve Officer*, Vol. 15, No. 10 (October 1938), pp. 19-20. E. A. Raymond, H. W. Baer, Jr. 1938.

A brief but competent survey of war gaming history. The importance of the map and map maneuvers is noted in describing the evolution of chess and chess-like games through the ages and the development of card games, lead soldier games, and Kriegsspiel with its many variants. With regard to the latter, the authors object to its increasingly complicated lists of rules and tables, dullness resulting from too-formalized game rules, and the considerable dependence on the umpire's subjective rulings to make the game play. Despite its limitations, however, the authors see in Kriegsspiel 'the germ of a war game which has actually been used . . . has proved entertaining . . . and can be constructed easily by any who wish to enjoy it.' 2 pp.

D-69508 'A Comparison of Performances of Danish and American Students in a 'Threat Game.' *Behavioral Science*, Vol. 16, No. 5 (September-October 1971), pp. 456-466. A. Rapoport, M. Guyer, D. Gordon. 1971.

Two experiments comparing the strategy choice behavior of American and Danish male college students were conducted. In the first experiment, pairs of American and Danish subjects played repeated trials of a variety of 2-by-2 non-zero-sum threat games. The results of this first study indicated a number of differences between the two populations in their use of and response to threats. The general pattern of results seemed to support the conjecture that, in the underdog role of the game, Danes are more submissive than Americans. In the top-dog role of the game Americans are somewhat more fair than Danes. In the second experiment, 60 American and 60 Danish subjects played repeated trials of a variety of threat games against a programmed stooge opponent. Several different stooge strategies were employed so as to systematically vary the behavior of the other. A number of systematic differences between the American and Danish players emerged in their responses to the different stooge strategies. These differences between Americans and Danes playing against the stooge player were consistent with those observed in the bona fide pairs. 11 pp.

D-70211 *The Game Monologs* (Santa Monica: The Rand Corporation, RM-1917-1-PR, March 1960). J. R. Renshaw, A. Heuston. March 1960.

An account of Monologs, a game developed in Rand's Logistics Department in which a player or group of players manages a simplified, simulated Air Force supply system consisting of one depot and five two-wing bases that phase in during the game. The game allows players to 'practice' inventory management and gain insight into inventory-control problems. In particular, the player acts as the inventory manager for 'widget,' a high-value, depot-reparable spare part, making the major decisions of inventory control that a real-world manager has to make. Informed of the given costs and lead times for each of his actions, he initiates procurement, plans repair schedules, and sets inventory and distribution policies. In accord with actual Air Force experience, demand for the widget is made a random variable beyond the player's control. He is given certain limited information, on the basis of which he must predict demand and establish inventory levels. He makes decisions and eventually learns their consequences. The game runs through a simulated period of 31 months, at the end of which the player computes his score, i.e., the total costs his actions incurred. Scores from prior runs of the game are included in this report. 33 pp.

D-71131 'Leuven Laboratory for Experimental Social Psychology,' *Administrative Science Quarterly*, Vol. 14, No. 2 (June 1960, pp. 254-259). J. Rijsman 1969.

This laboratory at the University of Louvain (Leuven), Belgium, covers about 400 square meters. It was designed to allow maximum manipulation and control of social factors; accurate measurements and registration of individual and group behavior; the possibility for advanced training in research; and adaptability to changing experimental needs. Rooms are provided for small groups, large groups, assistants' offices, and observation; and individual booths are available for subjects. 6 pp.

D-71781 *Communication and Large Organizations* (Santa Monica: System Development Corporation, SP-1690/000/00). B. Rome, S. Rome. September 1964.

Not abstracted; reviewed in R-732-ARPA.

D-71782 *Game Theory and Politics: Recent Soviet Views* (Santa Monica: The Rand Corporation, RM-5839-PR, 1970). T. W. Robinson. May 1970.

A useful survey of Soviet activity in game theory. It contains translations of four Soviet articles on game theory and politics, preceded by an analysis of Soviet game theory and an account of the development of the social sciences in the Soviet Union. The translations include articles by G. Gerasimov, N. Vorob'ev, and L. Petrovskaia. The author points out that Soviet scientists and social scientists have had to soft-pedal the political science aspects of game theory. They have circumvented this restriction to some extent by devoting attention to criticizing U.S. political science. Judging from this monograph and other recent articles on Soviet gaming, Soviet work in the field should advance considerably within the next few years. 127 pp.

D-71783 'Teaching With Inter-Nation Simulation and Case Studies,' *American Political Science Review*, Vol. 60 (1966), pp. 53-65. J. A. Robinson, L. F. Anderson, M. G. Hermann, R. C. Snyder. 1966.

This reports on a method devised and employed by the authors to test whether students learn certain facts and concepts better by examining case studies or by playing the Inter-Nation Simulation game. A group of 250 upper-division undergraduates at Northwestern and Rutgers universities took part in the 'quasi-experiment' (the authors' own term). The students were divided into two groups of approximately equal sex, intelligence, etc. One group concentrated on study by simulation but was exposed to the case-study method; the other group followed the reverse procedure. General results are as follows. More simulation students preferred case studies than case-study students preferred simulation. Neither method increased interest in the use of supplementary facilities, such as the library reading room, or caused students to visit professors more often. Simulation students attended classes more regularly. Simulation and case-study students differed insignificantly on two performance measures, fact mastery and principle mastery, i.e., 'no simple and direct associations between method and learning were found' (p. 62). The broad conclusion was that 'simulation is not uniformly superior to the case study as a supplementary teaching activity' (p. 64). However, simulation students found the course more useful and participated in more extra class sessions than did case-study students. More analyses of this rigor are needed. 13 pp.

D-71784 'Strategy in Games and Folk Tales,' *Journal of Social Psychology*, Vol. 61 (1963), pp. 185-199. J. M. Roberts, B. Sutton-Smith, A. Kendon. 1963.

This fascinating article focuses on the strategic mode of competition, not only as it appears in games of strategy but also as it occurs in folk tales with strategic outcomes. Games of strategy appear to be associated with high political integration, social stratification, animal husbandry, advanced agriculture and technology, large settlements, jurisdictional levels beyond the local community, high gods, and punishment of crimes by the government. It is suggested that complex societies can function only if a significant number of adults are socialized to life in a complex system. These are adults who have learned when and how to obey and disobey and when and how to command and not to command. The authors' principal findings were: (a) the strategic mode of competition is modeled in both games and folk tales in a number of cultures; (b) where the strategic mode of competition is modeled in one medium (i.e., games) it is likely to be modeled in the other (i.e., folk tales); and (c) the strategic mode of competition as modeled in

games and in folk tales is associated with obedience training and cultural complexity. It appears, further, that the strategic mode of competition is modeled more sharply in games than in tales and that, in general, game associations are stronger than tale associations. 15 pp.

D-74251 *A Theory of Pursuit and Evasion* (Santa Monica: The Rand Corporation, P-2606, 1962). C. Ryll-Nardzewski. August 1962.

Using game theoretical concepts, the author examines the problem of determining 'effective solutions' for general pursuit and evasion problems. It is maintained that such solutions are nearly impossible to attain except for a small class of problems characterized as being univalent, having optimal strategies defined for all initial conditions and continuous for all admissible motions. The author takes a problem from optimal control theory for which a solution exists and whose payoff function is defined as the amount of time it takes the pursuer and evader to reach a certain configuration from a given set of initial configurations. He devises ten theorems to describe how this problem might be gamed. In general, a highly sophisticated and narrow mathematical treatment of pursuit and evasion. 20 pp.

D-74501 *Map Maneuvers* (Fort Leavenworth, Kansas: U. S. Army Staff College Press, 1908). F. Sayre. 1908.

If nothing else, this short book reveals the timeless strengths and weaknesses of gaming as an analytical methodology. It gives a brief but thorough history of map games along with a description of maps and game rules as developed first by the Prussians and later by Livermore in this country. The author's recitation of the 'problems' of map and game play at Fort Leavenworth at the turn of the century could have come out of a contemporary Pentagon critique of almost any current game. Detailed rules tend to proliferate, causing a loss of interest in game play; play is too slow and interrupted by other demands on the players; there is constant tension between the simplification of the game and 'known' empirical detail from the real world; success of the game depends to a large extent upon the skill and charisma of the person in control; the format of the game reduces or eliminates innovative play; etc. This is a careful work that is worth reading even more for its good sense than for historical curiosity.

D-74502 'Age, Sex, Class, and Race Differences in Response to a Two-Person Non-Zero-Sum Game,' *Journal of Conflict Resolution*, Vol. 9, No. 2 (June 1965), pp. 212-220. E. E. Sampson, M. Kardush. 1965.

Using the payoff matrix developed by Scodel, Minas, Ratoosh, and Lipetz (D-75876, below), the authors conducted an experiment with children of different ages, sex, social class, and race. Although the subjects differed considerably from the college-adult population used in the original experiment, they performed similarly, except for some interesting and significant differences in their nonpreferred pattern of choices. What seemed to be most important in the subjects' minds were concepts of 'risk,' 'collaboration to equalize outcomes to both players,' 'maximizing one's own outcome,' and 'being polite and considerate by helping one's partner maximize his own outcome.' 9 pp.

D-75871 *On-Line Computer Programs for the Analysis of Border-Control Problems* (Santa Monica: The Rand Corporation, R-687-ARPA, February 1971). G. F. Schilling, M. Turner. February 1971.

The complex interactions of military, technical, geopolitical, and socioeconomic factors have posed a major problem in the devising of effective counter-infiltration programs. This report represents an effort to reduce that problem. The authors describe two versions of an on-line computer program for a previously developed model of border control that enables the user to analyze insurgent situations without mathematical manipulation (see RM-6250). The present computer program smooths the investigation of specific insurgent situations and permits the testing of quantitative sensitivity analyses of proposed border-security systems. Thus it allows rapid judgment of the probable utility of counter-infiltration methods in different contingencies. Outputs include a detailed account, over time, of the changing number of guerrillas in a specified area as a result of infiltration, interdiction, recruitment, and attrition. For any future date chosen, the program can give the total numbers, geographical density, and rate of change of guerrillas in a certain area. 63 pp.

D-75872 *Lanchester Models of Guerrilla Engagements* (Santa Monica: The Rand Corporation, RM-5053-ARPA, January 1967). M. B. Schaffer. January 1967

This study develops deterministic forms of Lanchester-type equations modeling small-force guerrilla engagements, which are typical of the early stages of insurgency. Three types of appropriate military activity are identified and treated mathematically: skirmish, ambush, and siege. In addition to the usual treatment of casualty production, these models include the effects of troop morale, troop captures, and supporting weapons. Since the descriptive equations are not amenable to closed-form solution, numerical results for illustrative parameters are obtained. 56 pp.

D-75873 *The Master Book of Mathematical Recreations* (New York: Dover, 1968, originally published in 1943). F. Schuh. 1968.

Not abstracted; reviewed in R-732-ARPA.

D-75874 *Urban Systems Gaming--Developments in Germany* (Paper presented at the Second International Gaming and Simulation Conference, Utrecht, Holland, July 1-4, 1971). H. Schren. July 1971.

A statement on the current status of urban gaming in West Germany. Despite the Germans' centuries-old interest in and practice of war gaming, they have pursued urban-planning gaming only since 1967. Nor have any distinctively German games been developed. Instead, American games have been transplanted, e.g., Duke's METRO and METROPOLIS, Feldt's CLUG, and Shirts' STARPOWER. Centers of urban gaming activity include the Technical University of Berlin, DATUM (a public opinion survey organization) at Bad Godesberg near Bonn, and the universities of Stuttgart, Cologne, and Karlsruhe. According to the author, a professor of planning and architecture at the Technical University of Berlin, German experience with the transplanted games has been uneven at best. Difficulties include communication and translation problems; structural differences between German and American cities; unclear or inadequate theoretical structures in the games; lack of documentation; and a general overestimation of what the games could be expected to accomplish. More disconcerting are the author's assertions that the games have been played with little regard for research or operational questions or purposes. In fact, he characterizes current German activity in urban gaming as the 'hobby' approach to problem-solving. 21 pp.

D-75875 'The Strategy of Conflict: Prospectus for a Reorientation of Game Theory,' *Journal of Conflict Resolution*, Vol. 2, No. 3 (September 1958), pp. 203-264. T. C. Schelling. 1958.

Coded: not abstracted; not reviewed.

D-75876 'Some Descriptive Aspects of Two-Person Non-Zero-Sum Games,' *Journal of Conflict Resolution*, Vol. 3, No. 2 (June 1959), pp. 114-119. A. Scodel, J. S. Minas, P. Katoosh, M. Lipetz. 1959.

Coded: not abstracted; not reviewed.

D-75877 'Problems in Political Gaming,' *Orbis* Vol. 9 (1965), pp. 677-693. D. C. Schwartz. 1965.

A weak and nearly incomprehensibly prolix article. The message, as well as one can decipher it, is the following: not many political scientist know much about gaming or simulation; the methods are intrinsically interesting, fascinating, compelling; if one elects to use the methods, he should be scientific. Being scientific includes considering the appropriateness of a game, the need for better gaming models, the necessity of adequately communicating a game model to the players, and the personalities of the role-players. Each topic warrants additional research. 17 pp.

D-77281 'Is Game Behavior Related to Behavior in Other Interpersonal Situations?' *Journal of Personality and Social Psychology*, Vol. 16, No. 1 (1970), pp. 92-109. V. Sermat. 1970.

A four-step experimental design was employed to sort out highly competitive from highly cooperative game players. The games of 'Chicken' and 'Prisoner's Dilemma' were used to do the initial sorting, and a mixed motive task and picture interpretation task were used to check the results. The fair to poor statistical results led the author to be pessimistic about the naive transfer and generalization of experimental results to more substantive contexts: '...the theoretical contribution of game research may have to be stated in other terms than its relevance to interpersonal behavior in real-life situations' (p. 108). The article provides a serviceable paradigm for experimentation with games and reviews much of the standard literature on 'threat and cooperative behavior. 17 pp.

D-77901 *Notes on N-Person Games VII: Cores of Convex Games* (Santa Monica: The Rand Corporation, RM-4571-PR, 1965). L. S. Shapley. October 1965.

This paper is one of a series of technical notes on topics in the mathematical theory of n-person games. Convex games are competitive situations in which there are strong incentives to form large coalitions; examples can be found in both commercial and diplomatic contexts. The core of an n-person game is characterized as the set of outcomes that cannot be blocked by any coalition of players. It is shown that the core of a convex game has a regular structure and that it is closely related to two other solution concepts: (1) the value solution is the center of gravity of the extreme points of the core; (2) the von Neumann-Morgenstern stable set solution is unique and coincides with the core. This is a rigorous and clear presentation of basic game theory. While the paper is not of central interest to gamers, the ideas of solution and solution space are important. 24 pp.

D-77902 *Some Topics in Two-Person Games* (Santa Monica: The Rand Corporation, RM-3672-1-PR, 1963). L. S. Shapley. October 1963.

This paper consists of several loosely related essays on the theory of finite, two-person games. The topics covered are, in brief, (1) the block decomposition of symmetric games, (2) saddlepoints in matrices having submatrices with saddlepoints, (3) generalized saddlepoints and 'order matrices,' (4) the existence of values in games with almost-perfect information, and (5) the nonconvergence of 'fictitious play' in non-zero-sum games. Throughout, there is an emphasis on features of the theory that depend only on the ordering of the payoffs, as opposed to their numerical values. The value of this work to the gamer is in showing where two-person zero-sum game theory results will hold with weaker conditions on the payoffs. This gives more latitude in model-building. 42 pp.

D-77903 *Concepts and Theories of Pure Competition* (Santa Monica: The Rand Corporation, RM-3553-PR, 1963). L. S. Shapley, M. Shubik. May 1963.

A classical formulation from the marketplace is examined from three different theoretical viewpoints, and the three solutions are contrasted. When the number of participants is small the solutions are very different, both in their form and in their quantitative predictions. As the size of the market increases, however, they all converge to a common solution, despite wide disparity in the underlying assumptions. A relationship is thereby demonstrated between (1) administered price stability (the competitive equilibrium), (2) non-collusive oligopolistic exploitation (the equilibrium point of a non-cooperative game), and (3) unrestricted bargaining between coalitions (the core of a cooperative game). The first model corresponds to the so-called Walras solution, the second to the Cournot solution, and the third to the Edgeworth solution. This is a rigorous, clear examination of classical market theory from a game theoretic perspective. The approach should be useful to those who are concerned with economic games. 34 pp.

D-77904 *Values of Large Market Games: Status of the Problem* (Santa Monica: The Rand Corporation, RM-3957-PR, 1964). L. S. Shapley. February 1964.

Several models of exchange economies with many participants are discussed, including the classical Walrasian *competitive equilibrium*, the *core* concept, and the *value* or determination of situational equity. Although these various 'solutions' converge when the number of traders is large, there is striking contrast between the sets of economic assumptions underlying each. The *core* is based on the possibility of forming large, efficient coalitions to control distribution. The *competitive equilibrium* is based on the decentralized management of the exchange mechanisms, with a minimum of information exchange and complete absence of collusion. *Value* corresponds to the idea of 'fair division,' a concept explored in some detail. It is concluded that the superficial similarity of the *core* and *value* solutions should not be allowed to obscure the fundamental differences that exist. Theorems are provided in mathematical appendices. Relevant literature is listed in the references. 18 pp.

D-77905 'A Note on a Simulated Stock Market,' *The Journal for the American Institute for Decision Sciences*, Vol. 1, Nos. 1 and 2 (January-April 1970), pp. 129-141. M. Shubik. January-April 1970.

This note describes a stock market game derived from a 'regular' business game and played in a simulated stock market. The possibility of using a stock market game as an experimental device to study expectations and market

behavior is discussed, and the data from a run of this game together with some analysis are presented. There were about a hundred players in this game. 21 pp.

D-77906 'Some Experimental Non-Zero-Sum Games with Lack of Information About the Rules,' *Management Science*, Vol. 8, No. 2 (January 1962). M. Shubik. January 1962.

A discussion of the relationship between the theory of games and experimental gaming. It includes comments on games of indefinite length and lack of knowledge concerning the rules. Six simple games are constructed and examined in the light of four different solution concepts. These games were used in an experiment with a class of Yale seniors as the subjects. The results of these experiments appear to lend weight to the non-cooperative equilibrium concept of solution.

D-77907 *The Dollar Auction Game: A Paradox in Non-cooperative Behavior and Escalation* (New Haven: Yale University, Dept. of Administrative Sciences, Report No. 30, 1970). M. Shubik. January 1970.

Description of a simple, highly amusing, and instructive parlor game that is based on the auction of a dollar. This game illustrates some of the difficulties of the non-cooperative equilibrium concept and games in extensive form. The game is usually highly profitable to its promoter. The auctioneer auctions off a dollar bill to the highest bidder, with the understanding that both the highest bidder and the second highest bidder will pay. For example, if A has bid 10 cents and B has bid 15 cents, then the auctioneer will obtain 25 cents, pay a dollar to B, and A will be out of pocket by 10 cents. The game provides a good analogy to the process of drug addiction. (Republished in *Journal of Conflict Resolution*, Vol. 15, No. 1 (1971), pp. 109-111.)

D-77908 'A Computer-Based Experimental Laboratory,' *Administrative Science Quarterly*, Vol. 14, No. 2 (June 1969), pp. 286-293. G. H. Shure, R. J. Meeker. June 1969.

This paper describes the work of the computer-based laboratory for behavioral research at the System Development Corporation, then one of the largest gaming laboratories. Several interesting studies were run on binary choice, leadership, computer-aided instruction, bargaining and negotiation, man-machine problem solving, organization and management, and international relations. The authors discuss problems of the pre-experimental assessment of individual differences among subjects: instruction and subject comprehension, preparation and presentation of experimental stimuli, experimental design, and control of social interaction through the simulation of subjects or artificial players. This is a useful introduction to some of the problems of laboratory design and how they influence experimentation in gaming. The authors make a convincing case for large-scale, highly computerized laboratory facilities. 8 pp.

D-77909 'A Personality/Attitude Schedule for Use in Experimental Bargaining Studies,' *The Journal of Psychology*, Vol. 65 (1967), pp. 233-52. G. H. Shure, R. J. Meeker. 1967.

This important article successfully bridges personality measurement, experimental gaming, and aspects of international relations. The authors devised their personality/attitude schedule by combining, according to factor analysis, portions of 10 existing attitude and personality scales, each measuring pacifism and belligerence in some degree. The new summary scale was then tested on five experimental populations. Low intercorrelations were found among the six summary factors for each population, a promising finding. Since then, two validity checks have been run by other researchers, with similarly promising results: (1) scale scores for 3 to 6 factors correlated significantly with game behavior (joint payoffs in a two-person, non-zero-sum game); (2) Crow and Noel reported that in experiments with the International Simulation, players' personalities, as determined by the Shure & Meeker personality/attitude schedule, significantly affected game behavior. The complete schedule is included. 20 pp

D-77910 'Empirical Demonstration of Normative Behavior in the Prisoner's Dilemma,' *Proceedings, 76th Annual Convention of the American Psychological Association* (1968), pp. 61-62. G. H. Shure, R. J. Meeker. 1968.

In a series of finely focused experiments, Shure and Meeker report results that demonstrate empirically that subjects will adopt a strategy of persistent dominant choice in a Prisoner's Dilemma game, i.e. a nominally rational strategy, if a condition of discontinuous relationships is satisfied. The article is a rare example of conciseness and high density of information for a social

science article. 2 pp.

D-77911 'The Effectiveness of Pacifist Strategies in Bargaining Games,' *Journal of Conflict Resolution*, Vol. 9, No. 1, (1965), pp. 106-117. G. H. Shure, R. J. Meeker, E. A. Hansford. 1965.

Using the laboratory facilities of the System Development Corporation, the authors attempted to measure the effectiveness of 'pure' pacifist strategies in controlled bargaining situations. Even allowing for the oversimplification and abstraction of the bargaining situation that result from devising a laboratory experiment, and allowing for the use of college-student, non-professional bargainers as subjects, the results were startling in their consistency. Pacifist tactics were shown to invite exploitation and aggression by those who did not share the pacifists' moral convictions. Furthermore, when the pacifist was identified and his intentions made known, he was still exploited. A tentative conclusion, appropriately qualified, was that pacifist strategies are inherently limited in a bargaining situation: weakness invites aggression. 12 pp.

D-77912 'TRACE Time-Shared Routines for Analysis, Classification and Evaluation,' *Spring Joint Computer Conference*, 1967, pp. 525-529. G. H. Shure, R. J. Meeker, W. H. Moore. 1967.

This article describes an ambitious and promising attempt to devise routines for analysis, classification, and evaluation of data generated from games. Its brevity does not permit the reader to evaluate the power of the programs and the 'language' being developed. Nevertheless, the problem to which it is addressed is well stated and the discussion is straightforward and sensible. 5 pp.

D-77913 'An Artificial Player for a Business Market Game,' *Simulation and Games*, Vol. 2, No. 1 (March 1971), pp. 27-43. M. Shubik, G. Wolf, S. Lockhart. March 1971.

A discussion of the difference between constructing an artificial player for a zero-sum game, such as chess, and for a non-constant-sum game, such as a business game. It is pointed out that in the former case, the social characteristics of the artificial player are of no importance, whereas in the latter case the social characteristics may be more important than problem-solving ability. In some sense social artificial intelligence may be different from problem-solving artificial intelligence. An artificial player for a business game is then described. The heuristic equations are discussed. This player was matched against 22 live players in a duopoly game. The artificial player was regarded by the live competitors as challenging and not easy to 'psych.' Most of the live players achieved a score higher than the artificial player: four had lower scores. 16 pp.

D-77914 *An Experimental Oligopoly Business Game* (New Haven: Yale University, Department of Administrative Sciences, Report No. 33, April 1970). M. Shubik, G. Wolf, H. B. Eisenberg. April 1970.

This reports on a series of economic games run with markets of 2, 3, 5, and 10 teams competing against each other. The main purpose of the game was to study the effect of increasing the number of competitors upon price levels and advertising. 50 pp. (See also D-77915.)

D-77915 *An Experimental Oligopoly Business Game: Part II. Some Theory, Mathematical Structure and Parameters* (New Haven: Yale University, Department of Administrative Sciences, Report No. 36, 1970). M. Shubik. December 1970.

This gives the theory behind the use of an oligopolistic market in an experimental business game (see D-77914). It analyzes, in particular, the mechanisms (including the joint maximum, non-cooperative equilibrium, and beat-the-average solutions) by which the effect of increasing the number of competitors is tested. 34 pp.

D-77916 'Man-Computer Derivations of Tree Structure From Multivariate Data,' *Proceedings, 76th Annual Convention, American Psychological Association* (1968), pp. 215-216. G. H. Shure, L. I. Press, M. S. Rogers. 1968.

IDEA is a computer program for inductive data exploration and analysis. It was developed for on-line interaction in the Q-32 computer time-sharing system. It is designed for discovering and summarizing potentially interesting data models in the form of restricted tree structures for a multivariate data base. Two other tree structure programs are compared with IDEA. 2 pp. (See also D-68622.)

D-77917 'New Book Analyzes Role of Force in International Relations,' *USA: Economics, Politics, Ideology*, No. 8 (Moscow: 1970), pp. 80-81. V. S. Shein. 1970.

This is a Soviet review of Hans Speier's 1969 book *Force and Folly*. The reviewer shows his ideological stripes: he places Speier in 'the right wing among those favoring a strict line in international affairs' and accuses him of producing 'fantasies regarding the Soviet Union and its foreign policies.' On balance, however, Shein summarizes the book well and gives a good brief description of the free-form gaming done at Rand in the late 1950s. 2 pp.

D-77918 *Extension of Max-Min Theory to the Sunk Investment Problem Arising in Strategic Systems Selection Decisions* (Silver Spring, Maryland: Naval Ordnance Laboratory, NOLTR 71-59, 19 May 1971). L. D. Shere, E. A. Cohen, Jr. 1971.

The selection of strategic retaliatory systems is one of the most significant problems facing the United States today. This report develops and solves the mathematical model for a general mix of percentage-vulnerable and numerically vulnerable systems. Percentage-vulnerable systems consist of mobile weapons that are difficult to locate but relatively easy to destroy once located; numerically vulnerable systems contain easily located, fixed-base weapons that are difficult to destroy. This analysis is distinctive in incorporating into the model the value of both the attacker's and the retaliator's existing weapon systems. 54 pp.

D-77919 'Game Theory, Behavior, and the Paradox of the Prisoner's Dilemma: Three Solutions,' *Journal of Conflict Resolution*, Vol. 14 (June 1970), pp. 181-193. M. Shubik. June 1970.

Presents three sharply different interpretations and analyses of the Prisoner's Dilemma, a deceptively simple 2-by-2 matrix game that can be used to illustrate the value and limitations of game-theoretic thinking. The game's simplicity makes it easy to experiment with and attractive as a paradigm to explain human behavior. But in the very simplicity lies the danger of implying that a substantial portion of the world can fit in a 2-by-2 matrix. Analogies between the game and human affairs are best used to identify inadequacies in the game rather than to derive information about human affairs. 12 pp.

D-77920 'Games of Status,' *Behavioral Science*, Vol. 16, No. 2 (March 1971), pp. 117-129. M. Shubik. 1971.

In a study intended to point toward possible applications of game-theoretic reasoning to sociological problems, mathematical models are used initially to examine the results of two-person non-constant-sum games in which a single value, status, is maximized, and subsequently to examine the results of multi-person games. The two-person, single-value-maximizing game quickly demonstrates behavior to be purely competitive. The multi-person game illustrates possibilities of coalition behavior, as demonstrated elsewhere in game theory, which includes the possibility of combinations against individual players, but the outcomes are highly sensitive to the values assigned to status factors, as in pecking orders and potlatches. The relationship between games of status and simple games is also examined. 13 pp.

D-79061 *Analytic Formulation of a Theater Air-Ground Warfare System* (Santa Monica: The Rand Corporation, RM-1338, September 1954). C. P. Siska, L. A. Giamboni, J. R. Lind. September 1954.

Draft contingency plans for the deployment of forces in wartime are often tested by being used in a war game, to ascertain if the plan is feasible, fulfills the objectives, and can be improved. But war games take so much time and skilled effort, however, that it may be possible to test only one plan, to the exclusion of another plan of perhaps equal merit. If the less important details of war gaming could be eliminated and only the important ones retained, more plans could be tested. Though a simplified game would produce less definitive results, at least it would show the sensitivity of results to assumptions. The more promising plans could then be given a standard, detailed war-gaming test. Much time and labor is also spent in evaluating the results of a single round of action. Evaluation is assigned to an umpire and his staff, who rely on a combination of experience, judgment, and mathematical analysis. If the details of war games were aggregated and the role of the umpire were mechanized, war gaming could be done faster and more easily. In 1950, J. E. Lipp initiated a program at Rand to study the feasibility of describing theater warfare so as to permit war gaming using a high-speed computer. This report describes a part of that program, the mechanization of theater war on a Reeves electronic analogue computer (REAC), specifi-

cally the incorporation of a command panel for the air commander of each side so that aircraft could be allocated at any time and in any proportion to a variety of missions. 51 pp.

D-79062 *Man-Machine Simulation Models* (New York: John Wiley & Sons, Inc., 1969). A. I. Siegel, J. J. Wolf. 1969.

Not abstracted; reviewed in R-732-ARPA.

D-79063 'Games,' *Systems and Procedures*, Vol. 12 (May 1961), pp. 32-36. R. L. Sisson. 1961.

At best this is a short, public-relations type of description of games. 5 pp.

D-80081 'Sex Differences in the Risks a Person Selects for Himself and the Risks He Selects for Someone Else,' *Oregon Research Institute Bulletin*, Vol. 7, No. 10 (October 1967). P. Slovic, M. S. Weinstein, S. Lichtenstein. October 1967.

This is a report of an experimental study on risk-taking and delegated risk-taking. The results of a fairly simple experiment with 102 male and female undergraduates showed some sex difference in risk-taking, with women's choices being more conservative than men's. However, no difference in fiduciary risk-taking was observed. More work should be done on this important subject. This report is not wholly satisfying. It does not place the experiment in its theoretical context, and the experiment does not seem to have been rigorous enough for one to have confidence in the present interpretation of results. 13 pp.

D-80082 'Differential Effects of Real Versus Hypothetical Payoffs on Choices Among Gambles,' *Journal of Experimental Psychology*, Vol. 80, No. 3 (1969), pp. 434-437. P. Slovic. 1969.

Report of an experiment in which 213 undergraduate men were assigned to two groups and were asked to indicate the gamble that they would most prefer to play in each of 18 pairs of gambles. The subjects (Ss) in Group H (N=184) made choices but did not actually play any of them. The Ss in Group RP (N=29), after making their choices, played a number of gambles to determine their salary. When choices were hypothetical, Ss maximized gain and discounted the possibilities of loss. When Ss knew they would have to play their preferred gambles, they were more cautious, preferring better odds and smaller losses than did Ss under the hypothetical conditions. More information on the naivete or sophistication of the Ss and more interpretation of the results would have improved this article. 4 pp.

D-80281 *The Game of Go* (Rutland, Vermont: Tuttle, 1956). A. Smith. 1956.

The invention of the game of *Go* is attributed to Wu, a vassal of the Chinese emperor who reigned 1818-1767 B.C. The oldest reference in Chinese works (about 1000 B.C.) is to a game easily recognizable as *Go*, which is mentioned so casually that it must have been well known at the time. At the beginning of the 17th century *Go* was highly developed by a group of expert players in Japan. This book was originally published in 1908. It is a good manual for learning to play the game.

D-80381 'Some Recent Trends in International Relations Theory and Research,' in Austin Ranney (ed.), *Essays on the Behavioral Study of Politics* (Urbana: University of Illinois Press, 1962), pp. 103-171. R. C. Snyder. 1962.

Even after the passage of much time, this essay remains one of the most comprehensive descriptions of the discipline of international relations ever written. It is well organized and outlines major trends succinctly. The author notes that much current work is pre-theoretical, judging from its attention to defining 'international relations'; to identifying the major conceptual problems, such as national interest, national character, collective security, sovereignty, nationalism, equilibrium, and power; and to making inventories and collecting data. The importance of gaming, both free-form and experimental, is recognized, and gaming is recommended for use in teaching, training, and theoretical study. The names of scholars then engaged in gaming are mentioned. This article represents the 'jumping-off place' for the political-diplomatic-military gamer. The author's conclusion, 'Hopefully we stand at the threshold of a period of further efforts to give greater depth and breadth to the confirmation of hypotheses and application of conceptual schemes' (p. 118), seems valid today. 69 pp.

D-8002 'Deterrence and Power,' *Journal of Conflict Resolution*, Vol. 4, No. 2 (June 1960), pp. 163-178. G. H. Snyder. 1960.

This examination of the deterrence concept zeroed in on the much-overlooked psychological factors in strategic gaming. It revealed that expectational factors --the balance of intentions--are central to deterrence theory and practice. Today, one can scarcely imagine a strategic war game that fails to take such factors explicitly into account. The author identifies the *credibility* of one's threat and the *rationality* of one's image or appearance as related psychological concerns that warrant more attention in research and actual gaming. Implicitly the article calls for much more rigorous experimentation on bargaining processes and behavior. The author's rather simple game-theoretic illustrations belie the complexity and importance of his main substantive points. Any strategic gamer who chooses to ignore intangibles in the interest of quantification and rigor could profit from a careful reading of this article. 16 pp.

D-81521 'War Games,' in M. Davis and M. Werhulst, eds., *Operations Research in Practice* (New Jersey: Pergamon Press, 1958. R. D. Specht. 1958.

Several examples of war games are described and some comments made about problems and values of gaming. The examples include large and small, high level and low, detailed and aggregated games; some use human umpiring, others make their assessments mechanically. There is a brief account of the work of the Total War Research Institute (established in Japan in 1940) in preparation for the attack on Pearl Harbor. American Kriegsspiel is also discussed. 19 pp.

D-81522 'A Laboratory Exercise for Information System Evaluation,' in J. Spiegel and D. Walker, eds., *Information System Sciences* (Washington, D.C.: Spartan Books, 1965), pp. 321-341. I. K. Cohen, R. L. Van Horn. 1965.

This is a convincing case for the merits of using a laboratory exercise to evaluate logistic systems, though the critical reader will undoubtedly disagree on one or two points. For example, sensitivity testing is dismissed with 'parameters that have little or no effect are eliminated from further research.' In the first place, how does one know what parameters have little effect, and second, is not the *value* of the effect more important than its *size*? Apart from a few such weaknesses, the article is worthwhile for its straightforward treatment of the uses and limits of laboratory testing of aspects of complex organizations. 21 pp.

D-81523 *Improvisation for the Theater* (Evanston: Northwestern University Press, 1963). V. Spolin. 1963.

Though this is a book about the theater, it is recommended to the gamer for its insights into the construction of free-form, manual games. Chapter 2, 'Workshop Procedures,' is especially useful for guidelines and for its comments on role-playing and direction, i.e., 'refereeing,' which have not been as cogently expressed in professional gaming treatises. Several examples will suggest Mrs. Spolin's perceptivity. On the use of games: 'Like dance or space exercises, games release spontaneity and create flow as they remove static body movements and bring the actors together physically. Games are especially valuable in cleaning up scenes requiring sharp timing' (p. 350). She defines a game as being an accepted group activity that is limited by rules and group agreement; fun, spontaneity, enthusiasm, and joy accompany games; games parallel the theater experience, and improvisation is structured like a game--and vice versa (p. 382). The direct relationship between games and theater has been noted by Neva Boyd in *Handbook of Games* (Chicago: Fitzsimons, 1945), to whom Mrs. Spolin acknowledges an intellectual and professional debt.

D-82031 *A Preliminary Treatment of Mobile SLBM Defense: Game-Theoretic Analysis* (Santa Monica: The Rand Corporation, RM-4439-ARPA, 1965). R. Strauch. June 1965.

A game theoretical analysis of the anti-submarine pursuit and evasion problem is developed for a mobile defense system against submarine-launched ballistic missiles. The payoff function for the attacker is the number of submarines that can successfully launch missiles. A game solution is developed for non-information contingency, and a partial solution is developed, for instance, of some information on the location of submarines. The solution is for only a limited number of parameters. This is a basically mathematical treatment of fundamental pursuit and evasion problems. A solid piece. 25 pp.

D-82032 'Management Games: Education or Entertainment?' *Personnel Journal*, Vol. 41 (January 1962), pp. 15-17, 23. J. D. Stanley. 1962.

The title asks a good question, but the author never gets around to answering it. A bit of pap ('games are good') for the busy and not very intelligent businessman or personnel administrator. 4 pp.

D-82033 'Cooperative and Competitive Price Bidding in a Duopoly Game,' *Behavioral Science*, Vol. 16, No. 6 (November 1971), pp. 545-557. F. J. Stech, C. G. McClintock. 1971.

Nine dyads played 20 trials of a duopoly price bidding game. On each trial the subjects submitted bids and received information about their own profits and the other's bid. Both members had identical cost and revenue functions, and the payoff relation between them was symmetrical. Over 60 percent of the price bids in the game were at or below the zero profit point, and only 12 percent of the bids were at the cooperative maximally profitable price. Structurally and empirically, the game had characteristics similar to the mixed-motive Prisoner's Dilemma. Although the subjects followed a strategy recommended by economic theory, the dilemma characteristics forced them to carry the strategy into the bid region below the lower limit suggested by economic considerations. Directions of bid shifts were strongly influenced by relative position (high or low bidder) on the previous trial and by both the player's own previous bid and the other's previous bid. Bids tended to shift gradually to the next higher or lower bid or to be maintained, and responses to the other's previous bid showed a similar pattern. Dyad members who won more or lost less money than their partners chose lower bids and responded differently to bids than did their partners. Bidding was used as a signalling channel to the other subject to overcome the lack of overt communication between dyad members. 13 pp.

D-82034 *SYMVU, Version 1* (Cambridge: Laboratory for Computer Graphics and Spatial Analysis, Harvard University, 1971). C. Steinmetz, L. Yont. 1971.

SYMVU is a three-dimensional surface-plotting package developed at the Harvard Computer Graphics Laboratory. SYMVU documentation, program decks, and the related but less sophisticated SYMAP, a two-dimensional plotting package, are all available for a fee from the laboratory. Both plotting packages have been used for urban and transportation analyses, models, and games, and are heavily user-oriented and quite cheap. For example, the SYMVU tape, reference-operator's manual, and sample output are listed at \$360 to nonprofit users and \$575 to others. For the interested gamer, these packages provide a useful and dramatic way to represent various game outcomes or to visually portray the results of a sensitivity analysis of a computer model used in the course of game play. Both packages are known to work and to be of quite high quality. 8 pp.

D-83391 *Instructional Simulation Systems* (Corvallis, Oregon: Continuing Education Publications, 1969). P. A. Twelker. 1969.

A bibliography of 1600 references on gaming and simulation that touches on a host of subjects including accounting, aeronautics, artificial intelligence, bargaining, behavioral sciences, business, cards, cognition, communication, computers, cultural relations, decisionmaking, defense, driver training, economics, education, game theory, geography, human engineering, international relations, learning, interpersonal relations, management, marketing, medicine, military science, operations research, performance, politics and government, psychology, and school administration. The references are annotated, but only to describe, not to evaluate, the contents. This limits their utility. The bibliography is selective in the sense that older, more frequently cited articles are left out, and the references favor instructional over, for example, experimental games. 286 pp.

D-84001 'Game Involvement in Adults,' *Journal of Social Psychology*, Vol. 60 (1963), pp. 15-30. B. Sutton-Smith, J. M. Roberts, R. M. Kozelka. 1963.

This article suggests that games of strategy are related to obedience training and to cultural complexity; that games of chance are associated with high responsibility training and belief in the benevolence of the gods; and that games of physical skill are related to an emphasis on achievement. The study behind these conclusions used the results of three polls taken in 1940 and 1948: (1) a 1940 Gallup poll, in which 3000 subjects were asked which games, of a list including tennis, golf, bridge, checkers, bingo, craps, and dice, they had played in the previous year; (2) the Minnesota poll #53 of 1948, in which 600 respondents were asked which activities, including fish-

ing, hunting, bowling, football, baseball, golf, skating, swimming, and 'watching sports contests,' they liked to do most in their spare time; and (3) the Roper-Fortune Survey #73 of 1948, devoted completely to recreation, in which 3000 subjects were classified by sex, income, education, and occupation. By encompassing all kinds of conflict, games are thought to provide participants with confidence that winning and losing (as complex interpersonal processes and anxiety-inducing processes) can be mastered. Thus, games may be regarded as a mechanism of personality adjustment, thereby serving an enculturative function. This otherwise excellent article is marred, for the game theorist, by a serious weakness in classifying games. The distinction between games of strategy and games of chance is not nearly as clear as the article implies. And the role of winning and losing needs greater elaboration. 15 pp.

D-84002 'The Economics Laboratory at UCSB,' *Simulation and Games*, Vol. 1, No. 1 (March 1970), pp. 81-91. J. J. Sullivan. 1970.

This laboratory was established in 1968 with the declared purpose of improving 'the quality and relevance' of the instruction in economics. It makes extensive use of a time-shared on-line computer system for teaching purposes. The laboratory has six 'teleputers' with 6-in. scopes and two with 11-in. scopes. Eight on-line terminals provide direct access to an IBM 360/75. The laboratory has a teleputer handbook, a simulation handbook for RUSH (a conversational subset of PL/I), and an economics data bank. In 1968-69 more than 200 students were introduced to the use of the equipment. Their experience covered both macro- and micro-economic models. Some indication of costs would have been useful. 10 pp.

D-84003 'What Is a Game?' *Philosophy of Science*, Vol. 34 (1967), pp. 148-156. B. Suits. 1967.

An interesting attempt to identify the distinctive features of a game. The opening disclaimer--'Encouraged by the modest belief that it is not demonstrably impossible for philosophers to say something of interest to scientists, I propose to formulate a definition of game-players'--sets the tone for the serious but witty discussion that follows. Game-playing involves inefficient means; rules and end are inseparable; game rules are not ultimately binding; means, not rules, are non-ultimate; and rules are accepted to allow the game activity. The end state of a game has three distinct aspects: doing whatever is necessary to terminate the game, e.g. cross the finish line, sink the final putt, etc.; winning, i.e. besting the opponent(s); and engaging in the activity of trying to win, i.e. playing the game. Well worth reading. 9 pp.

D-84461 'Games Used in Economic Management,' *The Current Digest of the Soviet Press*, Vol. 22, No. 44 (December 1970). I. Syroyezhin. December 1970.

This article, which originally appeared in *Izvestia*, discusses business gaming in the Soviet Union and describes a game played by factory administrators in the Lithuanian Republic. It is mainly a pitch by the author for the creation of a national center for economic games. The Soviet operations research profession has borrowed increasingly from American work in the last ten years. It is not surprising that business gaming is finding advocates there. The description of the Lithuanian exercise is not detailed enough to allow evaluation.

D-84462 'A Study of Consumer Behavior by Use of Competitive Business Games,' *Management Science*, Vol. 14, No. 7 (March 1968), pp. 473-485. G. H. Symonds. 1968.

The behavior of consumers, labor, investors, and community members in a simulated society is studied by use of competitive business games. The model for the simulation represents a closed economic system with firms in an oligopolistic industry operating by a set of anticipatory decision rules and a number of household communities whose decisions are made by players who identify themselves with the welfare of their communities. The product price and product sales each period are determined by equating the aggregate supply function of the firms and the aggregate demand function of the household communities. The wage rates and employment each period are determined by matching offers of the firms with offers of the household communities. 13 pp.

D-84501 *International System and Foreign Policy Approaches: Implications for Crisis Modelling and Management* (Michigan: University of Michigan, March 1971). R. Tinter. 1971.

This monograph brings together the many threads of current international

relations theory under the headings of stimulus-response, incremental, and mixed stimulus-response/incremental modes. The author proposes the creation of a Computer Aided Crisis Information System (CACIS), and he illustrates how it might work by elaborating on the Berlin Crisis of 1961. The footnotes could serve as a workable bibliography of current international relations sources. 32 pp.

D-85936 'The Role of Operational Gaming in Operations Research,' *The Journal of the Operations Research Society of America*, Vol. 5, No. 1 (February 1957), pp. 1-27. C. J. Thomas, W. L. Deemer, Jr. February 1957.

This article has stood the test of time because it is a first-rate general assessment of the methodological and practical strengths and weaknesses of gaming. The authors begin by comparing simulation, Monte Carlo gaming, and operational gaming. The relationship of game theory to operational gaming is clearly illustrated with a simple detection problem in anti-submarine warfare. The importance of gaming to simplify problems is stressed, and some qualitative differences between rigid and free-form games are noted in this regard. The heart of the paper, a comparison of gaming and non-gaming techniques in practice (pp. 19-25), is required reading for anyone interested in gaming. In it the authors assess nine alleged advantages of gaming. They are, in (for the authors) decreasing order of desirability, (1) selling and teaching the solution of games, (2) eliciting information from inarticulate experts, (3) stimulating the imagination, (4) incorporating intelligence interplay, (5) solving nonfactorable problems where context is important, (6) pooling the knowledge of experts, (7) determining balanced forces and estimating marginal utilities, (8) testing sensitivity over a wide range, and (9) incorporating actual probability distributions. 27 pp.

D-85937 *Why People Play Games--Report of a Survey* (Denver, Colorado: American Astronautical Society and Operations Research Society Meeting, June 17-20, 1969). C. J. Thomas, G. R. McNichols. 1969.

A useful and informative essay based on the replies of 100 gaming specialists to a survey on the applications of gaming. It presents a balanced view of the disadvantages and the virtues of the use of games. One of the authors conducted a similar survey ten years earlier that suggested applications limited mainly to the military. The present survey shows how the range of applications has broadened. The authors expect the uses, number of players, and number of professionals to increase. 22 pp.

D-88081 'World Game Pattern Recognition for Resource Utilization Planning,' paper given at 1970 Association for Computing Machinery Meetings (September 1970). T. B. Turner. September 1970.

This is another example of the ill-founded attempts to publicize Buckminster Fuller's 'World Game.' Were the salesmanship evidenced in this and other promotional activities convertible into the coin of the realm, Fuller would probably already have generated more than the \$16 million that he claims is needed to set the World Game in operation. As patent as the nonsense is, several responsible public agencies have shown more than passing interest in the enterprise: HR 17467, 91st Congress, 2nd Session, May 21, 1970, called for several millions of dollars to support the endeavor, and the state legislature of Illinois has proffered \$4 million in matching funds for it. 9 pp.

D-88761 'The Teaching Computer as a Gaming Laboratory,' *Simulation and Games*, Vol. 2, No. 1 (March 1971), pp. 5-25. S. Umpleby. March 1971.

This naive description of the PLATO system concludes merely that a gaming lab is a good thing. 21 pp.

D-88411 *On Behavior Strategy Solutions in Finite Extended Decision Processes* (Lafayette, Ind.: Purdue University School of Electrical Engineering, June 1970). V. A. Utgoff, R. L. Kashyap. June 1970.

This report considers the problem of determining the best behavior strategies for a decisionmaker in a two-person, zero-sum, finite extended decision situation. 'Best' strategies are defined as those that maximize a player's expected return against all possible strategies that can be employed by the other player. The decision process is thus considered a two-person, zero-sum, finite extended game. Techniques are developed for finding the best behavior strategies using arbitrary information-collection schemes. These techniques make it possible to search in any given game for strategies that are minimally complex but acceptably effective. A doctor-patient medical game is 'searched' using these techniques, and behavior strategies are found for the doctor that are more than 90 percent as effective but less than 10 percent as complex as the best strategy that results when the doctor gathers

and retains all the information defined to be available to him. A pursuit and evasion game is also studied and best behavior strategies are determined for the pursuer and the evader when each gathers and retains all the information available to him. 178 pp.

D-90501 'Validation of Simulation Results.' *Management Science*, Vol. 17, No. 5 (January 1971), pp. 247-257. R. L. Van Horn. 1971.

The author suggests that simulation models are designed and used to learn about a process. Validation is the act of increasing to an acceptable level one's confidence that an inference about a simulated process is correct for the actual process. There is no single best validation test. One selects a subset of tests from all possibilities, and in so doing confronts a standard decision problem of balancing test costs against the costs of inferring incorrectly. There are purposes for constructing simulations and criteria for judging the 'validity' of simulations other than those that Van Horn suggests. For example, a simulation could be constructed as a data-organizing device to be built-in parallel with a data bank; or, it could be used to teach the importance of consistency and thoroughness in model-building. Those purposes would require quite different validation criteria than the few specified in the article. In short, when adequate data are available, statistical tests are an essential part of validation, but only a part. Other possible validation tests are (in order of decreasing value-cost ratio): (1) find models at high face validity; (2) make use of existing research experience, observation, and any other available knowledge to supplement models; (3) conduct simple empirical tests of means variance and distribution by using available data; (4) run 'Turing'-type tests; (5) apply complex statistical tests to available data; (6) engage in special data collection; (7) run prototype and field tests; and (8) implement the results with little or no validation. The real task of validation is selecting an appropriate subset of tests to be used given a specific simulation with a specific purpose. 10 pp.

D-90501 'Simulation, Reality, and Theory in International Relations.' *World Politics*, Vol. 16, No. 3 (April 1964), pp. 490-519. S. Verba. April 1964.

This lengthy book review of three reports on INS (Inter-Nation Simulation) does little more than perpetuate popular clichés about simulation. The reviewer's negligible experience with the methodology perhaps accounts for his insubstantial criticism of the reviewed books. One tires of reading the n-th ode to the beauty and promise of simulation. What is needed, rather, is informed and sharp appraisal. 25 pp.

D-90511 *Misslogs: A Game of Missile Logistics* (Santa Monica: The Rand Corporation, RM-2455. September 1959). B. J. Voosen, D. Corona. September 1959.

This report describes a logistics game, Misslogs, developed in the Logistics Department of The Rand Corporation. The game demonstrates the interactions between logistics support and the operations of a ballistic missile squadron, with the player or group of players assuming the composite role of director of operations, supply, maintenance, and personnel at squadron level. Like its forerunners, Monologs and Baselogs, this game is designed as an educational device to further the understanding of logistic situations. Misslogs points up some of the areas in which bottlenecks are likely to occur and impede the smooth operation of a missile squadron, such as maintenance personnel and equipment, spares, and transportation. Each player receives the same fixed budget, which he may apportion as he sees fit among the resources in these areas. He thus becomes aware of the tradeoffs, both promising and unpromising, that are available. For example, he may find that he can add personnel to his squadron only at the cost of reducing his stock of spares. The object of the game is for the player to achieve a maximum state of readiness within the budget constraint. 14 pp.

D-90512 *PLANET: Planned Logistics Analysis and Evaluation Technique* (Santa Monica: The Rand Corporation, RM-4950-PR, January 1967). B. J. Voosen. January 1967.

A description of the PLANET model, which is a series of four computer simulation programs designed to examine the interaction between the hardware-configuration operations and logistics support of a variety of weapon systems in a single-base or multi-base environment. The author concisely describes the four simulators and the twelve output programs contained in the Reports and Analysis Library of the model and discusses the capabilities and limitations of the PLANET complex. 43 pp.

D-90501 'Group Influence on Individual Risk-taking.' *Journal of Abnormal and Social Psychology*, Vol. 65, No. 2 (1962), pp. 75-86. M. A. Wallach, N. Kogan, D. J. Bem. 1962.

This experimental study concludes that people are willing to take higher risks as members of a group than as individuals. A shift in willingness to take risks was observed as a result of group interaction. The shift manifested itself under several controlled conditions and persisted in a group over time. Possible explanations are that (1) individuals may be emboldened by the belief that responsibility is diffused, not personalized, in corporate decisions, and that (2) individual high-risk-takers may exert personal influence over the more cautious members of the group so as to sway the entire group toward riskier choices. These conclusions have serious implications for certain kinds of gaming as well as for certain situations in the real world. 12 pp.

D-90502 'The Roles of Information, Discussion, and Consensus in Group Risk Taking.' *Journal of Experimental Social Psychology*, Vol. 1 (1965), pp. 1-19. M. A. Wallach, N. Kogan. 1965.

This study, a sequel to an earlier experiment (see D-90501), supports the latter's conclusion that people are willing to take higher risks as members of a group than as individuals. The most consistent explanation for that finding seemed to be the effect of verbal discussion, which led group members to sense diffused responsibility for a risk. Alternative explanations, provision of information about peer group preferences and the achievement of consensus, were not borne out when tested. The implications for bureaucratic decisionmaking are noteworthy. A list of the relevant literature is appended. 19 pp.

D-91611 *International Stability* (Santa Monica: The Rand Corporation, P-3420, 1966). D. M. Weiler. August 1966.

This paper discusses generally the concept of stability in international politics. Implicit in the discussion is the requirement for multiple, specialized models for various analytic and policy contingencies. The need is outlined in terms of distinct spatial, political, symbolic, economic, military, and other specialized models. Differences between idealistic and instrumental perspectives on stability are sketched. This is a good, brief indicator of the pre- or nontheoretic status of much political science and international relations. The limitations are serious and ought not to be overlooked by 'hard' gamers bent on formalizing and quantifying. 10 pp.

D-91612 *An Introduction to War Games* (Santa Monica: The Rand Corporation, P-1773, 1959). M. G. Weiner. August 1959.

This is an excellent survey of war gaming from early times to the present. The author distinguishes two types of war games and analyzes their differences. This study remains timely today. It should be read with D-91613. 40 pp.

D-91613 *War Gaming Methodology* (Santa Monica: The Rand Corporation, RM-2413). M. G. Weiner. July 1959.

Not abstracted; reviewed in R-732-ARPA.

D-91614 *Bibliography of Simulations: Social Systems and Education* (La Jolla, Calif.: Western Behavioral Sciences Institute, January 15, 1969). R. Werner, J. T. Werner. 1969.

Coded; not abstracted; not reviewed.

D-91615 'Gaming.' in E. S. Quade and W. I. Boucher, eds., *Systems Analysis and Policy Planning: Applications in Defense* (New York: American Elsevier, 1968), pp. 265-278. M. G. Weiner. 1968.

Weiner discusses several aspects of gaming methodology with authority and common sense. The short sections on what games are and can do and what they are not and cannot do are concise gems of wisdom. A sample war game is 'walked through' to show the novice about the preparation, play, analysis, and follow-up phases of gaming. A single tactical game is shown in three separate applications to illustrate how the character of, and demands placed on, a game change dramatically with changes in the application or intended purpose of the game. We recommend this article highly. 14 pp.

D-93431 *The Production and Evaluation of Three Computer-Based Economics Games for the Sixth Grade* (Westchester County, New York: Board of Cooperative Educational Services, 1967). R. L. Wing, M. Addis, W. Goodman, J. Leonard, W. McKay. June 1967.

Not abstracted; reviewed in R-732-ARPA.

D-9432 'Competitive Bidding With Disparate Information.' *Management Science*, Vol. 15, No. 7 (March 1969), pp. 446-448. R. B. Wilson. March 1969.

This paper analyzes competitive bidding via sealed tenders when the bidders have different sources and amounts of information available above the value of the prize. Equilibrium-pure strategies are characterized, and computational methods are derived. A simple example is solved completely. 3 pp.

D-9433 *The Complete Strategist: Being a Primer on the Theory of Games of Strategy* (New York: McGraw-Hill, 1966). J. D. Williams. 1966.

Coded; not abstracted; not reviewed.

D-9434 'Forms of Social Control in Two-Person, Two-Choice Games.' *Behavioral Science*, Vol. 7 (1962), pp. 92-102. K. V. Wilson, V. E. Bixenstine. 1962.

The importance of power as an influence on choice of strategies is analyzed, and the application of game-theoretic concepts to real-life social conflicts is discussed. In mixed-motive games, the amount of control a player can exercise over his own and his opponents' gains and losses obviously has an important influence on choices of strategy for both. 11 pp.

D-9435 *Some Methods for Determining the Most Vital Link in a Railway Network* (Santa Monica: The Rand Corporation, RM-3321-ISA, 1963). R. D. Wollmer. April 1963.

Though not highly technical, this mathematical, operations-research approach to a military problem is useful. Railroad interdiction problems are specified in terms of network theory: terminals, supply centers, and junctions are viewed as nodes, and sections of tracks as links. Two kinds of interdiction problems are considered. In the first, it is assumed that the adversary has an unlimited number of trains, and that the best strategy is to attack that link whose disruption would most severely curtail the number of trains that could go through the railway system. In the second, it is assumed that the adversary has a limited number of trains, and that it would be best to attack that link whose disruption would force trains to take the longest routes. The algorithms for determining the critical link in each situation are presented and used to calculate the desired results. Both algorithms may be modified to find the most effective nodes to interdict as well. It would be desirable to investigate a policy for interdicting several links to restrict the flow of supplies or to lengthen the required routes. The theory presented here could be used for this purpose, but the calculations required would not make it practicable. 34 pp.

D-9452 *Behavioral Processes in Different Minimal Social Situations* (New Haven: Yale University, unpublished paper, 1970). G. Wolf. 1970.

In two experiments using a minimal social situation (the Prisoner's Dilemma), the timing of responses, source of reward, and scenario details were manipulated to ascertain which of these three factors most affected competitive and cooperative behavior. The effects were interpreted by analogy to economics and communications in the real world. Only the scenario details were found to affect behavior significantly. Cooperative behavior was increased by using an interpersonal communication scenario, cooperative expectations, and prior cooperative behavior. Competitive behavior was increased by using an economic decision scenario that posited competitive expectations and prior competitive behavior. However, while the dyads differed in the kinds of sequential patterns produced, knowledge of the past four responses produced high predictability. 18 pp.

D-9453 *Interpersonal Systems* (New Haven: Yale University, Technical Paper, 1970). G. Wolf. 1970.

Social interaction between two persons may be viewed as an information-processing continuum: each case of interaction involves the acquisition (perception and memory), evaluation (testing of the interpersonal relationship), and implementation (decisionmaking) of information by each person. This paper analyzes mainly the evaluation aspect and constructs a theory and method of information evaluation by integrating theories of one-way influence, two-way influence, and formal analyses from game theory. 14 pp.

D-95001 *The Education of a Poker Player* (New Jersey: Simon and Schuster, 1957). H. O. Yardley. 1957.

This classic not only gives a sound discussion of the probabilistic aspects of poker, it also has a side benefit in presenting the author's delightful anecdotes of his vicissitudes in learning the game. The book can be read as literature, as an instruction manual, or to understand poker as a social activity. Excellent, well worth reading.

D-95001 *Four Simulations from Creative Studies Inc.: Contract Negotiations, Managing the Worker, The Personnel Department, and Reorganization* (New York: McMillan, 1970). J. J. Zif. 1970.

Coded; not abstracted; not reviewed.

D-95001 'Games Can Teach the Boss His Business.' *CHANGING TIMES* The Kiplinger Magazine (November 1970), pp. 45-47. November 1970.

This is a brief, popular article on gaming, and not a very good one at that. It names a few games and a few organizations with commercial interest in gaming. The prime use is to bring the idea of gaming to the awareness of the uninformed reader. 3 pp.

D-95002 *World Politics Simulation* (Washington, D.C.: Industrial College of the Armed Forces, 1969). 1969.

Not abstracted; reviewed in R-732-ARPA.

D-95003 *Directory of Organizations and Activities Engaged or Interested in War Gaming* (Bethesda, Maryland: United States Army Strategy and Tactics Analysis Group, 1963). May 1963.

A directory and bibliography compiled with data from a U.S. Army survey of gaming activity at the end of 1961. The activities of 88 gaming groups, including those in the U.S., U.K., and Canada, are described. Gaming is classified as strategic or tactical, and each classification is further broken down into combat, logistics, intelligence, equipment feasibility, and miscellaneous categories. (See R-732-ARPA for a review.)

D-95004 *Manual War Gaming* (Newport, Rhode Island: United States Naval War College, 1969). January 1969.

This is a competent, straightforward presentation of manual gaming including a brief description of re-game procedures, damage assessment, a detailed description of a sample war game, and appendices covering damage assessment tables, rules, flow charts, formats, tables of random numbers, etc. A fair amount of the writing appears to have been lifted out of previous work on war gaming by Francis McHugh of the Naval War College. This is more an instruction manual than an analytic or even descriptive study. One could learn, for example, how to stage a tactical naval manual war game.

D-95005 *The General* (Baltimore, Maryland: Avalon Hill Co., since 1963). 1971.

This is a bi-monthly magazine published by the Avalon Hill Company that is directed to the war-game aficionado. Circulation is around 17,000. It deserves the attention of the serious gamer. The designer of an operational game may, for example, overlook the fact that what causes boredom in games for fun may cause boredom in serious games as well. *The General* has had several valuable comments on this topic. Particularly, the lead column, 'Avalon Hill Philosophy,' often has useful information.

D-95006 *Seventy-Five Years of Fun: The Story of Parker Brothers, Inc.* (Salem, Mass.: Parker Brothers, Inc., 1958). 1958.

This is a small advertising pamphlet published by the entertainment-game manufacturer Parker Bros. It contains a wealth of offbeat information, such as the dates of the introduction of Ping-Pong and the jigsaw puzzle and the history of Parker Bros. games. Despite overtones of hagiography, it is worth reading for the light it sheds on how and why certain games have become popular.

D-95007 *Recommended System of Toy Classification* (New York: Toy Manufacturers of the U.S.A., Inc., 1965). 1965.

In this standard classification system used by the American Association of Toy Manufacturers, no less than 19 categories of toys, including games and puzzles, are identified. The toy industry is a big and growing business. Gross sales, at \$8.38 million in 1960, had reached \$2.25 billion by 1970. Figures are unavailable on what proportion of the gross is attributable to games. 16

pp.

D-95910 *Notices of Research Projects in Gaming, Game Theory* (Washington: Science Information Exchange, Smithsonian Institution, 1971). 1971.

Science Information Exchange of the Smithsonian Institution provides, for a reasonable fee, a literature search on one of many topics. We requested one on gaming and game theory. The search turned up a few interesting references, but for the professional gamer there is not much new information, and for the novice the references would not be very useful. This is a competent and well-intentioned library service; its deficiencies merely point up the hazard of having adequate technical search procedures without adequate selection and cataloging of publications. The value of such a service depends on having high-level professional participation. It will become even more important that publications be well scrutinized and evaluated before being made available for retrieval, if for no other reason than to reduce the volume of required reading.

D-95910 'Navy Unveils Electronic War "Game": U.S. Naval Institute Proceedings (January 1959), pp. 136-137. 1959.

Coded: not abstracted; not reviewed.

D-95910 *Simulation: Technical Journal of Simulation Councils, Inc.* (La Jolla: Simulation Councils Inc., Published Monthly, 1963 to date). 1971.

Not abstracted; reviewed in R-732-ARPA.

D-95911 *First Tooling-Up Exercise for Logistics Systems Laboratory* (October-November 1956) (Santa Monica: The Rand Corporation, RM-1924, July 1957). July 1957.

This paper describes the first exercise, called PROLOG, of Rand's LSL. The exercise was designed to educate the staff of the LSL in the laboratory technique and to study the adaptation of that technique to logistics problems. 35 pp.

D-95912 'The War Game and How It Is Played: Mimic Warfare for the Schooling of Army Officers,' *Scientific American* (December 5, 1914), pp. 470-471. 1914.

Of historical interest, this article describes gaming activities at the National War College circa 1914. Pointed comments are made about the small size of the U.S. armed forces at the time, for example, in stating that gaming was resorted to as a substitute for exercises of actual troops. 'Our army now numbers thousands--these gentlemen play the map game with hundreds of thousands, what we would require in time of war, and they know that such a number is necessary--and strive their mightiest to learn how to hold the enemy in check with our little handful until the volunteers may be trained, which takes months! May the day of sacrifice be deferred!' (p. 471). We see that gaming was used for advocacy, even in 1914. The game itself is summarized in sufficient detail for us to know that it used two teams plus control, and that play was manual, of sequential moves, in variable-time, and on a map-board. Levels of resolution extended from division- to small-unit-size map grids. Emphasis was placed more on maneuver than on ultimate warfare objectives. This article provides historical perspective on war gaming in the United States. 2 pp.

D-95913 'New Tools: Education's Emerging Technology,' *Progressive Architecture*, Vol. 69, No. 4 (April 1968), pp. 134-145. April 1968.

A concise yet comprehensive review of technology in education, including facilities, equipment, uses, and costs. 'Edu-business' is described in terms of the work of several prominent contractors, such as RCA Instructional Systems, Raytheon Learning Systems, and Encyclopedia Britannica Education Corporation. The prime enabling legislation is the Elementary and Second-

ary Education Act of 1965 (ESEA), whose Title III is discussed extensively. It provides monies for R & D in education and has stimulated the development of educational laboratories in a number of demonstration projects, for example, Stanford in Palo Alto, California, and Encyclopedia Britannica in Lexington, North Carolina. For the gamer, this article is important in showing that, with existing legislation and technology, laboratory facilities can be constructed for educational gaming. To date, activity has centered on Computer Aided Instruction (CAI) in the more conventional sense. The ESEA's express provision for the construction of 'Regional Resource Centers' has not been exploited as it might be. Also of interest, several architectural firms are beginning to specialize in the construction of educational laboratories. The future for these activities seems promising, and educational gaming probably has an important role to play in that future. 12 pp.

D-95914 *Spartan International: The Magazine of Simulation Games* (Long Beach, Calif.: Spartan International, since 1969). 1971.

This is a monthly magazine published for the wargaming buff. The discussions of the possible financial rewards of entering tournaments and the detailed discussions of game play indicate that its readers, though few (circulation is less than 500), are serious and avid. One wishes that communications among operational war gamers were as good as those evident here among war gaming hobbyists. (See also D-97505.)

D-95915 *The State-of-the-Art in Urban Gaming Models* (Environmentics, Inc. for the Department of Transportation, Washington, D.C.; July 1971). July 1971.

Not abstracted; reviewed in R-732-ARPA.

D-95916 'Children's Games and Sports,' *Encyclopedia Britannica*, Vol. 5 (1969), pp. 517-520. 1969.

This is a less informative article than one would expect from the *Encyclopedia Britannica*. Nevertheless, it provides several useful insights and a useful bibliography. 4 pp.

D-95917 *Mathematical Model Building in Economics and Industry* (London and New York: Hafner Publishing Co., 1963). C-E-I-R Ltd. 1963.

This is a useful collection of articles that apply to the theory and practice of model-building. The professional gamer and modeler is particularly advised to read N. G. Kendall, 'Introduction to Model Building and Its Problems'; R. J. Beck, 'Econometric Models'; J. R. N. Stone, 'Economic and Social Modeling'; and H. D. Wold, 'Model Building and the Scientific Method.' The tone of the articles is free from the pitchforkism that one finds in similar works by predominantly American contributors. The book could serve nicely as the text for an introductory course in gaming and simulation methods at the advanced undergraduate or graduate level. The professional will be interested in such applications as the modeling of an oil company, air traffic control, and automobile traffic in Rome. 165 pp.

D-95918 *Game Theory and Its Application to the Social Sciences: A Bibliography* (Washington, D.C.: Bureau of Intelligence and Research, U.S. Department of State, January 1964). External Research Staff, U.S. Department of State. January 1964.

A good bibliography surveying the literature on game theory, international relations games, and some work in business and management games for 1961-1963. 12 pp.

D-95919 Environmental Systems Group, Institute of Ecology, University of California, Davis. *A Model of Society*, Report No. 1 (Davis, Calif.: April 1969). April 1969.

Description of a project worthy in intent but hopelessly large in scope. If the authors concentrate on one or two questions of the many they claim the model can handle, they may be able to obtain some valuable information.

Appendix A
SAMPLE CODING SHEET

401-1 (Rev. 7/71) **GAMING BIBLIOGRAPHY - LONG FORM**

01 SEQUENCE NUMBER: 196,001
 01 AUTHOR: H. O. Yardley
 02 TEXT: H. O. Yardley, The Education of a Poker Player, New Jersey: Simon and Schuster, 1937.
 DESCRIPTOR: H. O. Yardley, The Education of a Poker Player, Business, Entertainment, Excellent, 1937

03 ATTRIBUTES*:

1-0	PURPOSE: OTHER	0-0	QUALITATIVE ASSESSMENT: 1. NOT EVALUATIVE	0
1-1	PURPOSE: TEACHING	0-1	QUALITATIVE ASSESSMENT: 2. EXCELLENT	1-2
1-2	PURPOSE: TRAINING	0-2	QUALITATIVE ASSESSMENT: 3. OF NOTE	3-4
1-3	PURPOSE: OPERATIONAL	0-3	QUALITATIVE ASSESSMENT: 4. MODAL	3-6
1-4	PURPOSE: EXPERIMENTAL	0-4	QUALITATIVE ASSESSMENT: 5. LIMITED USE	7-8
1-5	PURPOSE: ENTERTAINMENT	0-5	QUALITATIVE ASSESSMENT: 6. BAD	9-10
1-6	PURPOSE: RESEARCH/THEORY			
1-7	DEVELOPMENT			
1-8	PURPOSE: POPULARIZATION, ADVOCACY			
2-0	SUBJECT: OTHER	0-6	CLASSIFICATION: NA; UNCLASSIFIED	
2-1	SUBJECT: BUSINESS/ORG/LOGISTICS	0-7	CLASSIFICATION: FONO	
2-2	SUBJECT: POLITICAL-DIPLOMATIC-MILITARY	0-8	CLASSIFICATION: CONFIDENTIAL	
2-3	SUBJECT: SOCIAL PSYCHOLOGY/PSYCHIATRY	0-9	CLASSIFICATION: SECRET	
2-4	SUBJECT: ARTIFICIAL INTELLIGENCE	1-0	CLASSIFICATION: TOP SECRET	
2-5	SUBJECT: POLITICAL SCIENCE	1-1	CLASSIFICATION: NATO CONFIDENTIAL	
2-6	SUBJECT: SOCIOLOGY/ORGANIZATION THEORY	1-2	RAND PUBLICATION: NA; NOT RAND	
2-7	SUBJECT: ECONOMICS	1-3	RAND PUBLICATION: DOCUMENT; INTERNAL	
2-8	SUBJECT: EDUCATION	1-4	NOTE: WORKING NOTE	
2-9	SUBJECT: BARGAINING/BIDDING	1-5	RAND PUBLICATION: PAPER	
2-10	SUBJECT: GAME THEORY	1-6	RAND PUBLICATION: RESEARCH	
2-11	SUBJECT: GAMING THEORY, METHODOLOGY & TECHNOLOGY	1-7	MEMORANDUM; REPORT	
2-12	SUBJECT: URBAN PLANNING/ECOLOGY	1-8		
2-13	SUBJECT: NA: GAMING	1-9		
3-0	ARTICLE TYPE: DESCRIPTIVE	1-10	FUNDING SOURCE: NA	
3-1	ARTICLE TYPE: RELATED TOPIC, RELEVANT	1-11	FUNDING SOURCE: ADPA	
3-2	ARTICLE TYPE: GAME DESCRIPTION/	1-12	FUNDING SOURCE: ACS	
3-3	ARTICLE TYPE: GAME DOCUMENTATION	1-13	FUNDING SOURCE: USA	
3-4	ARTICLE TYPE: GAME RESULTS	1-14	FUNDING SOURCE: USN	
3-5	MATHEMATICAL SOPHISTICATION: 1. NAIVE	1-15	FUNDING SOURCE: OTHER DOD	
3-6	MATHEMATICAL SOPHISTICATION: 2. SLIGHT	1-16	FUNDING SOURCE: OTHER US GOVERNMENT	
3-7	MATHEMATICAL SOPHISTICATION: 3. MODERATE	1-17	FUNDING SOURCE: UNIVERSITY	
3-8	MATHEMATICAL SOPHISTICATION: 4. NEEDLING	1-18	FUNDING SOURCE: FOUNDATION	
3-9	MATHEMATICAL SOPHISTICATION: 5. HIGH	1-19	FUNDING SOURCE: PRIVATE (BUSINESS, SELF, MISC.)	
3-10		1-20	FUNDING SOURCE: OTHER	
3-11	TYPE PUBLICATION: BOOK	1-21	YEAR PUBLISHED: 1943 OR REPORT	
3-12	TYPE PUBLICATION: BIBLIOGRAPHY	1-22	YEAR PUBLISHED: 1944-1950	
3-13	TYPE PUBLICATION: JOURNAL ARTICLE/CHAPTER IN A BOOK	1-23	YEAR PUBLISHED: 1951-1955	
3-14	TYPE PUBLICATION: TECHNICAL REPORT	1-24	YEAR PUBLISHED: 1956-1960	
3-15	TYPE PUBLICATION: UNPUBLISHED PAPER	1-25	YEAR PUBLISHED: 1961-1965	
3-16	TYPE PUBLICATION: POPULAR ARTICLE MAGAZINE	1-26	YEAR PUBLISHED: 1966-1970	
3-17	ABSTRACTED: NO	1-27	YEAR PUBLISHED: 1971-	
3-18	ABSTRACTED: YES			
3-19	ABSTRACTED: REVIEWED			
3-20	ABSTRACTED: AUTHOR			
		1-28	GAMING NAME (PAPER)	lackey
		1-29	GAMING FACILITY (lackey
				lackey
				lackey

* The order of the attributes on this form differs from that presented in Section II, but the information is the same.

D-96001 The Education of a Poker Player (New Jersey: Simon and Schuster, 1957).
H. O. Yardley, 1957.

This classic not only gives a sound discussion of the probabilistic aspects of poker, it also has a side benefit in presenting the author's delightful anecdotes of his vicissitudes in learning the game. The book can be read as literature, as an instruction manual, or to understand poker as a social activity. Excellent, well worth reading.

Appendix B

PRODUCTION

The various output formats shown in Sections III-V were produced from a single input format—the filled-in coding sheet (see Appendix A). That is one of the beauties of Rand's Text and Catalog System, the set of computer programs that was adapted for this literature survey. Originating in the parsing and grammar software developed by members of a Rand linguistics project in the early 1960s, this system is currently used to produce a variety of indexes and bibliographies of corporate publications.

As he read his quota of publications, each author marked the appropriate categories and drafted an abstract on a coding sheet. The authors met weekly to discuss and reach accord on the contents of the accumulated coding sheets. The sheets then passed to the production system, where their contents were typed on the IBM Magnetic Tape Selectric Typewriter (MT/ST), an office machine designed to speed the correction and editing of typewritten material. The hard copy was proof-read by the authors and corrections made to the MT/ST tapes. The corrected tape was then put through an IEM 2495 Converter multiplexed to Rand's IBM 360/65 computer, and processed using the Text and Catalog routines mentioned above. Drafts of Sections III-V of this Report were obtained merely by calling for a printout of this tape in three different outputs. To obtain the more refined printing job needed for the final Report, the same tape was sent outside Rand to be run through an RCA Spectra 70/35 and RCA Videocomp. This process not only produces typeset galleys in a variety of type sizes and faces, but also justifies and hyphenates lines according to standard algorithms.

This system is not perfect. The reader may notice, for example, that alphabetization is correct only to the first two characters of an author's last name. But such faults are tolerable because in other respects the system is so convenient, reliable, and cost-effective.